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Yarrow's Spiny Lizard
Sceloporus jarrovi immucronatus

From a water-color painting
made direct from life near Jacala, Hidalgo, Mexico,
on March 15, 1949, by George Miksch Sutton.

A PAINTING OF YARROW'S SPINY LIZARD

GEORGE MIKSCH SUTTON

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All my life I have been interested in the facial expressions of birds. One of my earliest publications dealt with the subject (Sutton, 1922, *Wilson Bull.*, 34:141–147). I did not mention in that paper any of the several ways in which a bird's facial expressions may resemble those of a lizard, a reason for this being that I had not paid as much attention to lizards as I had to birds. Today it seems to me that lizards have remarkably birdlike faces—or perhaps I should say that birds have remarkably lizard-like faces: I'm not sure which statement carries my thought the more perfectly.

In my several visits to Mexico I have paid special attention to the lizards. At our Rancho Rinconada home on the Río Sabinas, in southwestern Tamaulipas, in the spring of 1941, a lizard that caught flies on the screen of our dining-room window became a sort of pet. I caught this lizard, gave it a whiff of carbon tetrachloride, and painted it direct from life (though it looked pretty dead in the posture I chose for it), showing it in the claws of a Gray Hawk *(Buteo nitidus)*. When the lizard "came to" I released it at its favorite window, where it resumed its fly-catching almost instantly.

The subject of the direct-from-life drawing shown in the colorplate opposite I caught near our campsite 9 kilometers north of Jacala, Hidalgo, Mexico, on March 15, 1949. This time no carbon tetrachloride was used to quiet my model down; instead I tethered it with a stout thread and let it take what appeared to be a restful attitude on a small rock. The sun was exceedingly bright, so, sprawled on the ground in the shadow of our truck, with the lizard in sunlight just beyond the edge of the truck's shadow, I drew and painted, doing my best to capture on paper some of the vigor and sparkle of the creature I had captured. For a while it did not stay put very well; but unlike many of the live baby birds I have used as models from time to time, it finally accepted thread, rock and observer and remained quiet for minutes at a stretch, its only movements during these periods being quick, slight turnings of its head.

I never shall forget that particular camp-site. Roger Hurd, my companion, did his best to keep the pigs off while I was painting. He succeeded most of the time, but one sow and her brood had a way of moving in through the brush as quietly as a shadow and there was no telling what destruction such visits might entail. Roger and I, lizard forgotten for the nonce, hurled sticks, stones and epithets as meaningfully as we could and the enemy that had over-run us so quietly noisily withdrew. Back to my drawing I went only to realize that two winsome children, a little girl and her younger brother, neither over eight years old, had come bearing gifts—an egg, a cup of milk, some tortillas. The children were the owners of the bothersome pigs for all we knew. The boy was wearing a garment he did not need at the time, an old raincoat about three sizes too big for him, that I had given him.

The lizard specimen (University of Michigan Museum of Zoology Herpetological Collection No. 99785) is an adult male. Its total length is 195 mm. (snout to vent: 80 mm.). My distinguished friend, Charles F. Walker, of the Museum staff, has identified it as *Sceloporus jarrovi immucronatus*.

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FISHES FROM ARCHAEOLOGICAL SITES IN NORTHERN NEW MEXICO

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ABSTRACT. *Lepisosteus osseus, Gila robusta elegans,* and *Cycleptus elongatus* have been recovered from Pueblo Indian ruins in Chaco Canyon, Aztec, and Bandelier National Monument, respectively. All three species were probably utilized as food, but scales from *Lepisosteus* cf. *osseus* do not reveal the use to which they were put. Caudal vertebrae of *Gila r. elegans* and the urohyal bone of *Cycleptus* are diagnostic for these forms. *Lepisosteus* and *Cycleptus* are not presently known from northern New Mexico.

Fish remains associated with abandoned Indian pueblos may not only provide information about the food or other habits of the aborigines, but also contribute to a better understanding of their environment. For example, utilization of the huge Colorado squawfish, *Ptychocheilus lucius* Girard, by the Sobaipuri Indians of southern Arizona about two hundred years ago, supports the view that the San Pedro River was then a much larger and more stable stream than it was only three-quarters of a century ago (Miller, 1955; 1961). In addition, accurate identification of fish remains may enlarge our knowledge of zoogeography.

The material reported herein comes from three localities in northern New Mexico: Bandelier National Monument in the Rio Grande drainage, Sandoval County, and Chaco Canyon and Aztec Ruins National Monuments, both in the San Juan River drainage (Colorado River system), San Juan County. We are especially grateful to Lyndon L. Hargrave and the Southwest Archeological Center, Globe, Arizona, for providing the specimens and provenance data, and permitting us to make this report. Volney H. Jones and Richard Yarnell supplied references and criticized parts of the manuscript. Paul A. Judge, Superintendent at Bandelier, gave information on present stream conditions there, and Gordon Vivian furnished additional data for the Bandelier and Chaco Canyon specimens. Clark Hubbs and William J. Koster replied to our inquiries concerning the present range of *Cycleptus* in Texas and New Mexico, respectively.

LEPISOSTEUS OSSEUS (LINNAEUS), LONGNOSE GAR

Part of the left mandible of this species, 46 mm. in total length, com-

prising fragments of the retroarticular, angular, and dentary bones, comes from the general fill at Kin Kletso, Chaco Canyon National Monument. The specimen, No. C255, belonged to an individual probably more than two feet long. In addition, 25 scales of a gar are from Room 16 Fill, Kin Kletso (CC-KK-General). Although there is no question that these thick, shiny, rhomboidal scales with their conspicuous anterior and dorsal articulating processes represent the genus *Lepisosteus*, we are unable to identify them confidently to species. Possibly they too belong to *L. osseus*. Tree ring dates for Kin Kletso range from 1076 to 1178 A.D. (Vivian, *in litt.*).

Lepisosteus is not a member of the Colorado River fish fauna. The nearest existing species, *L. osseus*, occurs in the lower Pecos River and adjacent waters of New Mexico (Koster, 1957:24). It is quite possible that this or another species inhabited the upper Rio Grande in aboriginal times. This assumption perhaps gains support from the fact that paintings of freshwater gars appear on Indian pottery from sites along the Mimbres River in southwestern New Mexico (Cosgrove and Cosgrove, 1932: pls. 208–209). Although no gar now inhabits that stream, the species depicted may have been observed in the nearby Rio Grande. Cope and Yarrow (1875:639) reported that descriptions of gars in the Rio Grande were provided by "various intelligent persons." Their information was gained through observers assigned to the Wheeler Survey West of the 100th Meridian, 1871–1874, which traversed the Rio Grande only above El Paso, Texas.

Gar scales were previously reported from Chaco Canyon by Judd (1959:35, 127–128) who considered this fish to be a possible food item of the Pueblo Indians. Whether the species was used only for food or the scales were obtained by trade for ornamental purposes we cannot say. There is no visible modification of the 25 scales to suggest their use as jewelry, and it seems unlikely that the lower jaw would have been utilized in ornamentation. We believe that the gars were secured for food, but from the Rio Grande basin. Bryan (1954:39) concluded that no permanent or perennial stream existed in Chaco Canyon during its occupancy by the Pueblo Indians of concern here.

GILA ROBUSTA ELEGANS BAIRD AND GIRARD, BONYTAIL

Two detached caudal vertebrae, one of which is characteristic of those in the posterior part of the vertebral column, are referred to this well marked subspecies. Unlike other large, generically related minnows of the Colorado River system (*G. r. robusta* Baird and Girard, *G. cypha* Miller), the neural and haemal spines of the bonytail become nearly parallel with the vertebral axis in the region of the caudal

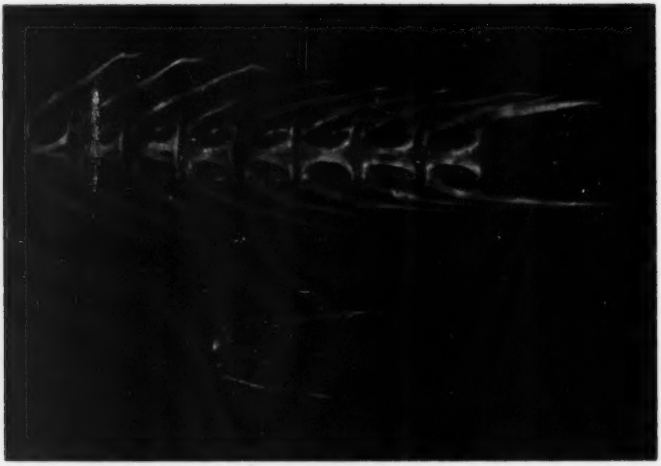

Fig. 1. Caudal vertebrae of Gila *robusta elegans*. Top: vertebrae nos. 31–38 of UMMZ 176972-S, 13⅜ in. S. L., from the lower Colorado River, California. Bottom: archaeological specimen AR-2542 from Aztec Ruins National Monument.

peduncle between about the 34th and 46th vertebrae (Fig. 1). The archaeological specimens, No. AR-2542, came from an individual or individuals estimated to have been nearly 14 inches in standard length. They are somewhat larger than the recent California specimen from which a skeleton was prepared for comparative purposes; the greatest width of the centrum of the figured vertebra is 7.5 mm., its height anteriorly 5.5 mm. Although it is undoubtedly that of *Gila r. elegans*, the other one might represent the roundtail, *Gila r. robusta*, also known from the region and attaining a size similar to that of the bonytail.

The two vertebrae were recovered from P-15 Fill, Aztec Ruins National Monument. They were associated with classic Mesa Verde pottery of an occupation probably dating after 1225 to about 1275 A.D. (Hargrave, *in litt.*). The site is adjacent to the Animas River, the largest tributary of the San Juan River, which it enters about 12 miles southwest of the Monument. If the bonytail was not obtained from Animas River it presumably could have been taken in the San Juan. At the present time only intergrades between *elegans* and *robusta* are known in this region.

Large individuals of *Gila robusta* are reported to be very tasty (Ellis, 1914:56). The bonytail was no doubt utilized for food by the aborigines, but its use was probably limited by the presence of the larger and less bony Colorado squawfish and humpback sucker, *Xyrauchen texanus* Abbott (Miller, 1955:127–130).

CYCLEPTUS ELONGATUS LESUEUR, BLUE SUCKER

A complete urohyal bone and a broken, incomplete Weberian apparatus including the first two vertebrae are referred to this species. They were recovered from level two or three of Kiva One, Rainbow House (LA 217), Bandelier National Monument, and are catalogued as No. B642. The bones were associated with Kidder's Glaze IV pottery which dates them between about 1550 and 1600 A.D. (Vivian, Hargrave, *in litt.*).

With its broad, strongly developed wings directed obliquely backward and originating at the anteroventral end of the bone, the urohyal is unlike that of any other genus of North American sucker and thus establishes without question its pertinence to the monotypic genus *Cycleptus* (Fig. 2). Comparison with urohyals from a male and female

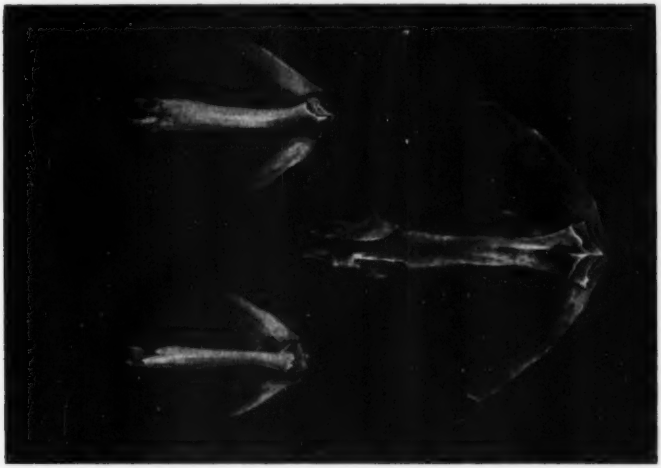

Fig. 2. Urohyal bones of *Cycleptus elongatus*. Right: archaeological specimen B642 from Bandelier National Monument. Upper left: specimen from a female, 16¼ in. S. L., UMMZ 176973-S, Red River, Texas. Lower left: specimen from a male, 14 in. S.L., UMMZ 176973-S.

of *C. elongatus* from the Red River, Texas, indicates that the Bandelier specimen belonged to a much larger individual. Width/ length ratios of the three specimens in order of decreasing size are 0.876, 0.750, and 0.646; the greatest length of each bone is 31.4, 20.0, and 17.8 mm., and their greatest widths are 27.5, 15.0, and 11.5 mm. We estimate that the Bandelier sucker represented by the urohyal was slightly over 25 inches in standard length.

The incomplete Weberian apparatus obviously came from a different, even larger individual. It is referred to the blue sucker because of the single pair of "transverse processes" arising from the second vertebra (Nelson, 1948). By establishing the ratio of the diameter of the second vertebra to the standard length of the recent specimens, we estimate that the fish represented by the archaeological specimen approached a standard length of 33 inches.

Cycleptus is not known to occur farther upstream in the Rio Grande than the vicinity of Big Bend National Park (Clark Hubbs, *in litt.*) and reaches its southern limit in the basins of the Río Salado, Nuevo León, and Río Conchos, Chihuahua, México, both tributaries of the Rio Grande. Koster (1957:39) reported it in New Mexico only from the lower Pecos River where it is rare, and Clark Hubbs (*in litt.*, 1960) indicated that it is not common in that river in Texas. Local inquiry by Gehlbach and a collection from the Rio Grande in White Rock Canyon made by R. R., G. H., and F. L. Miller in September, 1960, failed to produce any evidence of *Cycleptus* in the Bandelier region.

Trautman (1957: map 35) mapped the blue sucker's general distribution, excluding Mexico, as centering in the Mississippi Valley and indicated its preference for clear, fairly deep rivers of moderate current. Barnickol and Starrett (1951:292–293) have shown that the species is on the decline in the upper Mississippi River basin but did not specifically suggest, as did Trautman (1957:222), that increasing siltation and pollution are probable causes of its reduction.

Association of this species with the now abandoned Rainbow House indicates that the blue sucker once occurred in the upper Rio Grande basin. It seems doubtful that the Indians obtained it at great distances from their home pueblo, and there is no indication that this fish was utilized for anything other than food. While archaeological records of catostomid fishes are uncommon, suckers represent a readily available, widespread, and important food source (Rostlund, 1952:31–32). Trautman (1957:221) stated that *Cycleptus* is considered a highly valued food fish in the Ohio River, although its commercial value has dropped as the species has declined in abundance. This sucker attains reported maximum lengths of three feet or more and weights to 15 pounds; those between two and three feet long (probably about the original size of the two archaeological specimens recorded here) weigh three to ten pounds (Trautman, 1957:221).

Like other members of its family, *Cycleptus* engages in an annual spring spawning migration. Presumably at this time the Indians of Rainbow House caught the species as it ascended the nearby Rito de los Frijoles to the base of the lower falls which are about forty feet high. This barrier undoubtedly prevented farther upstream movement

(*vide* Wing, 1955:38, fig.). However, the fish may have been captured in the Rio Grande. Although the upper Rio Grande is not presently known to support *Cycleptus*, stream conditions during the occupation of Rainbow House evidently provided a favorable ecologic niche. This implies that the Rio Grande was a clearer, larger, and more stable stream than it is known to have been during the past century (Miller, 1961). Recent modification of the river system, resulting in extensive siltation and reduced flow, could have eliminated the blue sucker in northern New Mexico as it evidently did the longnose gar and shovelnose sturgeon, *Scaphirhynchus platorynchus* (Rafinesque) taken near Albuquerque in the early 1870's (Bailey and Cross, 1954:190, fig. 10).

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DIFFERENCES IN THE EGG COMPLEMENT OF *HADROPTERUS SCIERUS* FROM AUSTIN AND SAN MARCOS

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ABSTRACT. Eggs of *Hadropterus scierus* from near Austin, Texas, are smaller and more numerous than those from near San Marcos. The increased egg diameter correlates directly with intensity of interspecific competition and correlates inversely with intraspecific competition.

Many authors have shown that geographic variations occur in the egg complement of fishes (Katz, 1948; Mäar, 1949; Simpson, 1951). Svärdson (1949) has theorized that egg numbers of fishes are inversely correlated with competition intensity, primarily for available food supply. He showed that the number of eggs produced by a female at one time is in large part a product of her size and the egg diameter. The available nutrients can be concentrated into few large eggs or distributed over more small eggs. Under intense larval competition increased nutrients per egg would permit a greater survival. Otherwise, increased numbers of eggs would result in more individuals of that genotype in the next generation. Lack (1954) supported Svärdson's hypothesis and considered that the phenomenon applied to most animals. Hubbs (1958) and Hubbs and Delco (1960) have presented data that show the effects of intraspecific competition in reducing egg complements of darters. Evidence was presented in the second paper to suggest that the presence of a closely related species might reduce intraspecific competition and increase egg complement. A comparison of egg complements of *Hadropterus scierus*, the dusky darter, from Austin and San Marcos, Texas, is in accord with an association of increased egg number with reduced intraspecific competition and increased interspecific competition.

MATERIAL AND METHODS

Ripe female (and male) dusky darters were obtained from several localities within Texas. Variations among most areas were noted in egg size and complement. Adequate samples, however, are available only from the vicinities of Austin and San Marcos. The Austin sample is compiled from individuals collected from the Colorado River in

Austin one to six miles east-southeast of Tom Miller Dam, Barton Creek ½ mile southwest of its mouth in the Colorado River, and Onion Creek one mile south of the U.S. 183 bridge over the Colorado River. At all of these sites *H. scierus* is scarce. Although there is some fluctuation in population numbers (Hubbs and Hettler, 1959), the greatest population density is very low. Except for the two tributary creeks, collections typically contain more *Percina caprodes* than *H. scierus*. The San Marcos sample was compiled from individuals taken from the San Marcos River at Rio Vista Dam, Thompson Island, and a low water bridge respectively ½, 1, and 4 miles east-southeast of the San Marcos Springs. Populations near Rio Vista Dam vary from sparse to dense, and at the other localities large numbers can be collected at any time. Hubbs (1954) studied 131 dusky darter specimens from San Marcos and 11 specimens from Austin in his study of racial variations in the species. Specimens of *Percina caprodes* are seldom taken at any of the three localities. A collection containing two adults is an extremely rare occurrence. Thereby, the two samples differ by having much more intraspecific and much less interspecific competition at San Marcos.

The two populations also differ enough in other morphologic factors to warrant placing them in different subspecies (Hubbs, 1954).

Eggs were stripped from females following the techniques of Strawn and Hubbs (1956). Only the adhesive mature eggs were counted; therefore, changes of egg complement with egg maturation (Vladykov, 1956) do not distort the comparisons. Other potential sources of experimental error are as listed in Hubbs and Delco (1960). Any such experimental errors are equivalent in each sample, therefore the comparisons would remain valid.

EGG COMPLEMENTS

The number of eggs from the San Marcos females is clearly less than that from equal-sized females from Austin. (Figure 1.) The only overlap can easily be attributed to sample error. As the females were distended with eggs a larger egg complement necessitates smaller individual eggs. The difference in egg diameter between the 1.78 mm. San Marcos egg and the 1.64 mm. Austin egg is of far less than 1/1000 of being by chance.

The egg numbers presented here are notably less than those listed by Brown (1955) for a 65 mm. (656) and a 66 mm. (443) female from San Marcos. The figures for the smaller fish are clearly based on more than one spawn as Brown wrote that they were variable in size. The count for the 66 mm. female is probably based on mature eggs

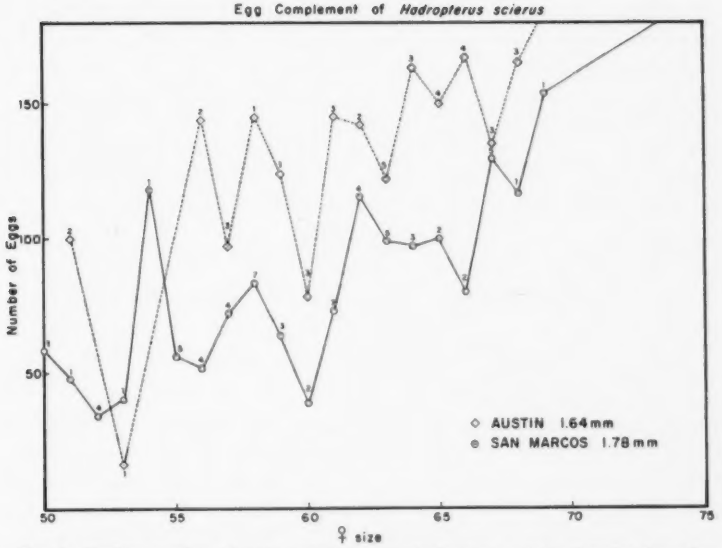

Fig. 1. Median number of eggs stripped from *Hadropterus scierus* females from San Marcos and Austin. Average between two median numbers is given if there is an even number of specimens of a given millimeter. The number of specimens is adjacent to the appropriate symbol. The average diameter of eggs water-hardened for 24 hours is givn in the key.

as he reported they were uniformly about 1.5 mm. in diameter. These eggs may have been not yet fully matured and the reduction of egg numbers with gamete maturity (Vladykov, 1956) might apply. It is more likely, however, that Brown had an egg-bound female and his count was of two spawns.

Nevertheless, the interpopulational comparisons remain valid. An increase in the number of adults of *H. scierus* would result in an increased competition between young. Therefore, any factor that increased the food supply for early larvae would give them a selective advantage over others of the same age group. Large eggs would be of more value in the dense San Marcos population than in the sparse populations around Austin. *Percina caprodes* adults often occupy the same habitat as *H. scierus* adults. It is likely that interspecific competition holds down the population density of each species. Interspecific competition is probably less in larvae than in adults.

CONCLUSION

Egg complements of two samples of *Hadropterus scierus* vary con-

siderably. The number of eggs correlates inversely with population density of *H. scierus* and directly with the population density of a related species, *Percina caprodes*.

ACKNOWLEDGMENTS

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NOTES ON THE PALLID BAT IN TEXAS

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ABSTRACT. A colony of pallid bats studied in the summer of 1959 consisted of young bats and adult females. Data on sex ratios, body and organ weights, identified insect remains beneath *Antrozous* roosts and two ectoparasitic mites are reported.

The pallid bat, *Antrozous pallidus* (Le Conte), occurs throughout much of the western United States. Members of the subspecies *A. p. pallidus* have been collected in several of the southwestern states, but the recorded eastern extreme is in Kerr County in central Texas (Mulaik, 1943; Blair, 1952; Hall and Kelson, 1959). The purpose of this paper is to note the occurrence of a colony of pallid bats in this eastern sector of its range, presenting data on organ weights, types of food, ectoparasites and behavior patterns.

On July 10, 1959 a colony of *A. p. pallidus* was discovered about seventeen miles west of Kerrville, Texas in the recreation hall of a summer camp, Camp Mystic. The author had frequently checked this hall for three months prior to this date, the last on July 5, but bats were not present during this period. It was evident from the guano deposits and the reports of local residents that this building had been used in previous years.

On July 10, the bats were found roosting at 5:30 p.m. between an inside roof support and the outside surface of a rock chimney. The air temperature was 32° C. The crack in which the bats were resting was about 25 feet from the floor of the hall. Observations at later dates indicated that the bats gained access to this day roost by entering the hall through open doors and windows. Approximately 50 to 60 pallid bats were present on July 10, but only 43 were captured. Ten of these were adult females, twelve young females and twenty-one young males. Although the young-of-the-year (young) were approximately the same size as the adults and were flying well, they were distinguished by the incomplete closure of their wing epiphises and by their relatively gray pelage. Seven of the adult females were found to be lactating. About one-half of the bats captured were used for the determination of organ weights while the others were marked and released about fifteen miles east of the roost.

On July 31, about 30 *Antrozous* were present at the Camp Mystic

roost. Twenty-five were captured, marked and released at the roost. Since none of these bats had been banded on July 10, at least some of the group seen this visit had not been present during the earlier trip. Eight of the 25 bats were adult females, ten were young females and seven were young males. Six of the adult females were still lactating.

Although the bats were not found in this roost again in the daytime, they continued to use the center of the recreation hall ceiling as a night roost.

During the night of October 5–6, 1959, thirty-three *Antrozous*, eight males and twenty-five females, were captured from the ceiling. None of the adult females was lactating. Many of the young could not be distinguished from the adults, but since all of the males previously found in this colony were young and some of the eight were still discernible as young animals, it is likely that all of the males present on this date were born in 1959. This assumption, the examination of tooth wear and mammary condition suggest that the age composition was 12 adults, 13 young females and 8 young males.

The above observations indicate that the pallid bats used the open ceiling of the recreation hall at Camp Mystic for a night roosting spot where insect prey were devoured, while they also occasionally used a crack along the top of the chimney for a day roost. This type of behavior has been described previously for *A. p. pacificus* (Orr, 1954). Since the bats were not observed in the shallow day roost prior to July 5, the young bats must have been born in a nearby roost and only after they were able to fly did the colony move to the chimney roost. It is probable that all of the bats from the maternal colony did not come to the chimney roost at once because a number of bats not marked on July 10 were present on July 31. These bats could have come from another maternal colony.

Since parturition was not observed, no accurate time of birth can be given. Orr (1954) observed that the time of birth varies with individual females in the same colony and apparently to some extent with locality and year. May 10 was the earliest date of parturition that Orr observed, and June 23 was the latest date. Cockrum (1955) presents July 4 as the latest date that females bearing embryos were taken. If these extremes are not drastically different for the *A. p. pallidus* specimens taken in Texas, the young pallid bats collected from Camp Mystic on July 10 were about one to two months of age. Since most of the adult females captured on July 31 were lactating even though the young were flying, the females probably lactate for at least two to three months.

The total sex ratio of the young bats for July 10 and 31 was not different than the expected 50:50 ratio. The total number of young

caught on these two dates was 50, while the number of adult females was 18. This ratio of 2.8 young per adult female is somewhat higher than the 1.8 reported by Cockrum (1955). This is either because some of the adult females did not come to this roost, that they were more difficult to net and were the majority of the bats that escaped, or that these females actually had a higher number of young born per litter.

Adult males were apparently absent from this roost during the period of study. This pattern of behavior conforms with Hall's (1946) observation that the "pallid bats separate by sex in spring before the young are born. The females are then in colonies."

BODY AND ORGAN WEIGHTS

On July 10, within four hours after capture, all of the 43 bats that were captured were weighed on an Ohaus double pan balance to the nearest tenth of a gram. Bats to be used for organ weight determinations were placed into a refrigerating unit at 10° C. until they could be examined. All bats were killed by dislocation of the cervical vertebrae within three days after capture and immediately autopsied. Organs were removed from each bat, blotted twice on absorbent tissue and weighed on a Roller-Smith balance to the nearest tenth of a milligram.

Body weight. On July 10 the adult females with a mean weight of 18.9 gms. and S.D. = 1.4 were heavier than the young bats of either sex ($P < 0.01$). The young females had a mean body weight, 13.8 gms. (S.D. = 1.2), that was greater than the young males, 12.2 gms. (S.D. = 1.4), $P < 0.01$. The mean forearm lengths of the adults were also larger than the young bats: adults, 5.30 cms., S.D. = 0.14 cms.; young females 5.10 cms., S.D. = 0.08; and young males 5.00 cms., S.D. = 0.22 cms.

Since five adult females (determined on the basis of considerable tooth wear) captured on October 5 and 6 had a mean weight of 23.2 grams (maximum 24.5 and minimum 21.0 gms.), a decided weight gain of several grams is apparent over the weight of 18.9 gms. for the bats collected on July 10. This increase in body weight has been noted in other species of bats in the fall months prior to migration or hibernation.

Organ Weights. The spleen weights of these bats were large (Table 1). The large size of this organ and its dark red coloration were probably caused by the low temperature at which the bats were maintained prior to death. Lidicker and Davis (1955) as well as Krutzsch (1959) have described the engorged condition of the spleen in some species of bats when they were exposed to low ambient temperatures. In agreement with these authors it was found that *Antrozous* specimens (not shown

TABLE 1

Organ weights of pallid bats (gms./100 gms. body weight)

	No.	Spleen Mean	Spleen S.D.	Heart Mean	Heart S.D.	Kidneys Mean	Kidneys S.D.	Adrenals Mean	Adrenals S.D.	Lungs Mean	Lungs S.D.	Liver Mean	Liver S.D.	Testes Mean	Testes S.D.	Ovaries Mean	Ovaries S.D.
Adult females	7	0.84	0.28	0.71	0.07	1.2	0.11	0.02	0.008	0.80	0.13	4.0	0.27	...	...	0.01	0.006
Young males	7	0.91	0.41	0.71	0.07	0.96	0.16	0.02	0.005	1.0	0.09	3.3	0.49	0.20	0.02	...	....
Young females	5	1.1	0.53	0.73	0.07	0.92	0.14	0.02	0.005	1.0	0.09	3.1	0.34	...	...	0.03	0.01

in Table 1) removed from a warm environment showed a much smaller, lighter colored spleen suggesting that a similar splenic engorgement under cold conditions also occurs in this genus.

It has been stated by authors such as Brody (1945) that the heart weight/body weight ratio tends to be dependent upon the amount of strenuous or vigorous activity an animal must undergo, with a proportionately large heart found in species normally experiencing periods of vigorous activity (i.e. "athletic" species). Thus, we might expect that bats would have large hearts, since they expend large amounts of energy in flight. However, the pallid bats had hearts which averaged only about 0.7 per cent of their body weights. This value when compared to the ratios listed in the Handbook of Biological Data (1956) for various mammals, does not seem to be unusually high.

The left kidney was generally located about 1.0 cm. more posteriad than the right. The mean weight of the left kidney (adults 108.5 mgms., S.D. = 12.0 mgms.; young females 60.2 mgms., S.D. = 7.1 mgms.; and young males 59.4 mgms., S.D. = 14.5 mgms.) was significantly ($P < 0.01$) less than the mean weights of the right kidney (adults 125.4 mgms., S.D. = 17.1 mgms.; young females 67.9 mgms., S.D. = 7.0 mgms.; young males 67.9 mgms., S.D. = 14.5 mgms.).

The right adrenal gland was generally situated on the most anterior aspect of the right kidney, while the left adrenal was located along the anterior lateral aspect of the kidney proximal to the midline of the body. The mean weight of the right adrenal (adults 1.7 mgms., S.D. = 0.8 mgms.; young females 1.0 mgms., S.D. = 0.2 mgms.; young males 1.0 mgms., S.D. = 0.5 mgms.) was less ($P < 0.01$) than the mean weight of the left adrenal gland (adults 2.4 mgms., S.D. = 0.8 mgms.; young females 1.4 mgms., S.D. = 0.3 mgms.; young males 1.2 mgms., S.D. = 0.5 mgms.). The adrenal weight/body weight relation of the pallid bat (Table 1) compares favorably with the value of 0.04 per cent stated for the vampire bat *Desmodus rotundus* (Handbook of Biological Data, 1956).

The right lung was found to be larger than the left lung in all of the pallid bats examined, $P < 0.01$.

The young males that were captured on July 10, 1959 had a mean weight of their right testes of 12.6 mgms. and 13.7 mgms. for their left testes (S.D. = 1.5 and 2.6 mgms.). When eight males were caught on October 5 and 6, the testes size had increased to the following: right testes with a mean weight of 61.7 mgms., S.D. = 33.9 mgms. and left testes with a mean weight of 65.9 mgms., S.D. = 30.7 mgms. Three of these males were known to be young-of-the-year; one had been banded in July and the other two could be differentiated on the basis of incomplete wing epiphseal closure. It is probable that all eight males

TABLE 2

Insect remains under bat roost

Order	Family	Number	Item
Dermaptera (?)		1	hind wing
Orthoptera		1	leg
	Acrididae	2	hind legs
		7	front wings (tegmina)
		9	hind wings
	Tettigoniidae	15	male front wings (tegmina)
		13	female front wings (tegmina)
		2	hind wings
		3	legs
		7	ovipositor valves
Odonata	Libellulidae	2	hind wings
Homoptera	Cicadidae	4	front wings
		1	hind wing
Hemiptera	Pentatomidae	2	front wings (nemelytra)
Neuroptera		8	wings
	Sialidae*	1	male mandible
	Chrysopidae	1	complete uneaten adult
Coleoptera		2	abdominal venters (with contents eaten out)
		11	front wings (elytra)
		11	hind wings
	Scarabaeidae**		
		9	front wings (elytra)
		1	leg
	Cerambycidae	1	head and antennae
		1	leg
		6	front wings (elytra)
Trichoptera (?)		1	front wing
		1	hind wing
Lepidoptera	Noctuidae	11	wings
	Saturniidae	1	wing
Hymenoptera	Scoliidae	1	front wing
		1	hind wing

* *Corydalus cornutus*
** *Pelidnota punctata* (L.)

were young. The testes in all but one specimen had either descended partially or completely into the cremaster sac. This descent and the increased testes weights suggest that the young males are physiologically capable of reproduction their first year. This suggestion is supported by the fact that one out of two bats that were checked by sperm smear had active spermatozoa present. This specimen was known to have been born in 1959.

The uterine horns of the adult females were approximately the same size and had regressed to a non-pregnant size.

FOOD

The pallid bat's habit of collecting at least some of its food from the ground and bringing it back to a night roosting spot where the prey is consumed has been noted by a number of authors. In spite of the frequent documentation, only a small number of insect types have been

identified from under *Antrozous* roosts. Since these previous reports were made in the more westerly parts of the pallid bat's range, it is particularly interesting to note the list of remains that were found among the guano deposits at the Camp Mystic roost (Table 2).

A large number of orders and families is represented in this collection. Only a few of these have been reported in earlier papers. Capture or consumption of Jerusalem Crickets and grasshoppers (Orthoptera) have been noted by a number of authors (Grinnell, 1918; Nelson, 1918; Howell, 1920; Hatt, 1923; Borell, 1942), while beetle remains (Coleoptera) have been found by Hatt (1923) and Borell (1942). Hatt noted the occurrence of scorpion remains under an *Antrozous* roost.

It is apparent that the majority of items in Table 2 consists of grasshoppers and beetles and that many of the groups that were collected either do not fly or do so infrequently. These data support the earlier reports that some of the pallid bat's food is captured on the ground. However, we must exercise care in concluding from these results that the identified forms comprise the major portion of this bat's diet. It is possible that the pallid bat catches and/or consumes much of its prey in flight and carries only certain types of food (e.g. large forms) back to the roost.

ECTOPARASITES

A number of mites that were removed from specimens of *Antrozous* were identified as *Ichoronyssus robustipes* (Ewing) of the family Dermanyssidae and *Spinturnix* sp. (Spinturnicidae).

SUMMARY

During the summer of 1959, a colony of pallid bats was discovered in Kerr County, Texas. The colony consisted of young bats able to fly and adult females. The ratio of young females to young males did not significantly deviate from the expected 50:50 ratio. The young bats were probably one to two months old. Adult females apparently lactate at least two to three months.

Data on body and organ weights were presented for adult and young bats. It was noted that the weight of the right kidney was greater than the left; the weight of the right adrenal gland was less than the left; and the weight of the right lung was greater than the left lung. There was a large increase in testes weight by October 6, when at least one young male had active sperm.

Identification of insect remains from under *Antrozous* roosts indicated that the orders Orthoptera and Coleoptera were the most abun-

dant forms found. Two species of mites were identified on *Antrozous* specimens, *Ichoronyssus robustipes* and *Spinturnix* sp.

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THE CARNIVORES AND UNGULATES OF THE ARANSAS NATIONAL WILDLIFE REFUGE, TEXAS

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ABSTRACT. A brief history and status of the carnivores and ungulates of the Aransas National Wildlife Refuge, Texas is presented. Coyotes, raccoons, striped skunks, bobcats, feral hogs, javelinas, and white-tailed deer are common to abundant. Red wolves and gray fox are uncommon. Ringtailed cat, badgers, and spotted skunks are rare. Introduced fallow deer have been eliminated and introduced mule deer never became established.

The Aransas National Wildlife Refuge in the coastal bend area of Texas is renowned as the wintering ground of the Whooping Crane (*Grus americana*), and as a source of thousands of white-tailed deer (*Odocoileus virginianus*) which have been transplanted elsewhere (Glazener, 1948). Much unpublished information has been accumulated on the ungulates and carnivores of this refuge. It is the purpose of this paper to summarize this information as a contribution to the ecology of one of America's most important wildlife refuges.

Gabrielson (1943) has told of the establishment of the area, which is managed by the Bureau of Sport Fisheries and Wildlife, U. S. Fish and Wildlife Service, Department of the Interior.

The author has made periodic field trips to the area between 1955 and 1960 to work on mammals and their management. Specimen records from the U. S. Biological Survey Collection, Washington, D.C. have kindly been supplied by Viola S. Schantz. Similar records from the Texas Cooperative Wildlife Collection at College Station, Texas, have been made available by Dr. William B. Davis, who also reviewed the manuscript. Refuge files have been consulted. The records of former Refuge Manager James O. Stevenson have been particularly valuable. Refuge Manager Huyson J. Johnson and his staff were most helpful.

The Aransas Refuge was established December 31, 1937, on the Texas coast in parts of Aransas, Refugio, and Calhoun counties. It occupies 47,261 acres of the Blackjack or St. Charles Peninsula. Much of the area is covered by live oak (*Quercus virginiana*) in both the tree and the shrub or shinnery form. The peninsula was named after the blackjack oak (*Q. marilandica*) which occurs in scattered inland stands. The rich flora of the refuge includes representatives from both

the east and the west. Salt flats are characteristic of the shoreline, and a wide variety of grasses is found in suitable habitats over the entire refuge.

A cooperative U. S. Weather Bureau station is maintained at refuge headquarters in the northeastern corner of the area. For the past 20 years (1940–1959) the average annual precipitation has been 34.51 inches with extremes of 17.36 and 47.44 inches.

Allen (1894), in listing the mammals of Aransas County, mentioned the former occurrence of mountain lion (*Felis concolor*), jaguar (*Felis onca*), and ocelot (*Felis pardalis*). These felids are not now found on the Aransas Refuge. He also mentioned that "formerly" bones and horns of the American bison (*Bison bison*) were "found on the prairies."

Fallow deer (*Dama dama*) were introduced in the 1930's (Halloran & Howard, 1956). The last sight records of this exotic species (some of which were live-trapped for the former owner) were made in 1949 when two were seen. Mule deer (Halloran & Howard, 1956) were also introduced but were not successful. Domestic cattle and a few saddle horses are pastured on a permit basis.

ORDER CARNIVORA

Canis latrans frustror Woodhouse.—The coyote is a common resident. Twenty-one specimens are in the Biological Survey Collection. The largest male of this series, trapped November 27, 1940, had standard measurements of 52″-15″-6¼″-5″ (notch), stood 25 inches at the shoulder and weighed 45 pounds. The largest of the females, taken October 24, 1940, had standard measurements of 46½″-13½″-6½″-4½″ (notch).

Canis niger rufus Audubon and Bachman.—Although the Texas red wolf is native, the earliest available record for the refuge is that of a male taken by George Kettley, December 13, 1939 (No. 265645 USBSC). Acting Refuge Manager Joshua J. Harman sent six *Canis* skulls to the U. S. National Museum, five of which were red wolves. They were all males, taken between January 27 and February 18, 1956, and weighed 27, 33, 38, 38, and 37 pounds respectively. Four wolves taken between November 1939 and January 1940 averaged 50 pounds. A fifth specimen taken during the same period weighed more than 60 pounds. Two red wolves from the Aransas Refuge are in the Texas Cooperative Wildlife Collection. Refuge records reveal that female wolves taken from May 5 to June 23, 1944, contained respectively six, eight, and nine unborn pups. In the Narrative Report of November 1939 to June 1940, C. C. Sperry of the Denver Wildlife Re-

search Center, Denver, Colorado, reported the results of analysis of eight male wolf stomachs: two were empty, two contained deer meat, two had cottontail, one contained horse meat carrion, and one was three-fourths full of calf.

A Denver Wildlife Research Center analysis of wolf stomachs taken between September 27 and November 27, 1940, is outlined in a November 1940 to January 1941 Aransas Refuge report as follows: rabbits (*Sylvilagus*) trace to 100% in six; carrion deer hide in one; deer hair in two; mole (*Scalopus*) in two; carrion hide (cow?) in one. One stomach held woody debris only and one stomach was empty.

Urocyon cinereoargenteus scotti Mearns. Hall and Kelson (1959) are followed in assigning the gray fox in Aransas County to *scotti*. The first refuge records were of nine taken in 1956. Since that time 13 more have been trapped (through December 1959). A male taken by refuge employee Earl L. Benham, January 21, 1959, was weighed, measured, and photographed. Standard measurements were 36¾"-15"-5⅛"-1¾" (notch). The entire weight was 8¾ pounds. This specimen was not saved as the skull was crushed.

Bassariscus astutus (Lichtenstein). No specimens of this species are known, but there is one sight record by former Refuge Manager Julian A. Howard, made between September 1 and December 31, 1954. The ringtail was flushed from a lumber pile at Refuge Headquarters.

Allen (1894) mentioned indefinite records of this species from the St. Charles peninsula on lands now within the refuge.

Procyon lotor fuscipes Mearns. The raccoon is abundant. During the period December 31, 1937 through 1959, 3464 racoons were trapped, of which 1052 were live trapped and transplanted by the Texas Game and Fish Commission. Of 153 males and 147 females taken during the period January to April, 1950, the heaviest male weighed 23 pounds, the heaviest female, 17 pounds.

In July 1940, student assistant Tarleton F. Smith examined 30 raccoon scats. He found "85% mustang grapes, 10% beetles and grasshoppers and 5% miscellaneous (mainly crabs)" (unpubl. report, refuge files).

Nasua narica (Linnaeus). Only two sight records are known of this species. J. Clark Salyer II and former Refuge Manager James O. Stevenson saw a coati at Mustang Lake April 28, 1939. Another coati was seen on May 15 of the same year. Most Texas records of this species are in the western half of the state (Davis, 1960).

Taxidea taxus littoralis Schantz. The badger is rare. A yearling

male collected October 1, 1941, by refuge employees Leslie E. Beaty and Arthur R. Custer at Bird Point is now No. 271788 in the Biological Survey Collection. An August to October 1940 refuge narrative report states that two young badgers were accidentally caught and released unharmed during that report period. A badger was seen at the north end of the refuge just east of headquarters by former Assistant Manager Charles Kennedy on August 10, 1958.

Spilogale putorius interrupta (Rafinesque). Van Gelder (1959) is followed in assigning the subspecies on the basis of geographic probability. A spotted skunk trapped by Earl L. Benham at the north end of the refuge in March 1959 is the first authentic local record. According to refuge employee B. F. "Frank" Brown, this skunk is occasionally seen at night foraging over refuge roads.

Mephitis mephitis mesomelas Lichtenstein. A striped skunk from the refuge is in the Biological Survey Collection, and one is in the Texas Cooperative Wildlife Collection. This species is a common resident.

Lynx rufus texensis J. A. Allen. Young (1958) stated that *texensis* is the subspecies found on the coastal bend of Texas. Six bobcats from the refuge are in the Biological Survey Collection. The largest of these, a male (No. 265635), had standard measurements of 40″-6½″-5¾″-3″ (notch) with height of shoulder 18¾″. Records indicate that from 1938–1959, inclusive, 138 bobcats were taken, including 57 in 1956. A series of 30 male bobcats taken between mid-January 1956 and mid-March 1957 averaged 23.8 pounds in weight with extremes of 18 and 32 pounds. Eleven females taken during the same period averaged 18.8 pounds each with extremes of 17 and 25 pounds.

Records of trapped females with unborn young are as follows: May 12, 4; June 17–25, 4,2,2; July 24–27, 2,4; August 3, 3.

ORDER ARTIODACTYLA

Sus scrofa Linnaeus. European wild boars were introduced on the St. Charles Peninsula prior to the time that the area became a refuge (Halloran and Howard, 1956). These animals interbred with local feral hogs.

On September 7, 1955, Viola S. Schantz wrote Refuge Manager Julian A. Howard as follows: "The European boar and our domestic pig are the same species *Sus scrofa*, but through selective breeding these animals vary greatly and therefore are not always distinguishable. The proportions of specimens 287576 and 387577 are quite simi-

lar to a European boar skull collected in Germany, excepting the first and second molars are shorter in these specimens, and compared with a domestic pig skull collected in Virginia, the above skulls have a longer snout, and are not as massive posteriorly."

Seven hundred eight-six of these feral hogs were killed between 1955 and 1959.

Tayassu tajacu angulatus (Cope). Javelinas are native to the area. Three specimens are in the Biological Survey Collection and two are in the Texas Cooperative Wildlife Collection. A javelina hit by a car on the refuge July 24, 1941, had a height at shoulders of 19 inches, a total length of 36⅞ inches, and an entire weight of 57 pounds.

From 1953 through 1959, 135 javelinas were live-trapped and released on West Texas ranges by the Texas Game and Fish Commission. In July 1939, student assistant Pierce B. Uzzell found that javelinas were feeding on persimmon and prickly pear fruits (unpubl. report, refuge files).

Between November 16, 1957, and January 8, 1958, the Texas Game and Fish Commission crew trapped 29 javelinas, 14 of which were considered from their small size to be young of the year. A javelina in the immature reddish-brown pelage was seen close at the heels of an adult at Moss Lake in the northwestern part of the refuge on May 19, 1958.

Odocoileus virginianus mcilhennyi F. W. Miller. Twenty-three Aransas deer in the U. S. Biological Survey Collection are classified as *mcilhnnyi*. Halloran (1943) outlined early herd history and its relationship to cattle management. During a period of 20 seasons (1940–41 to 1959–60, inclusive) 12,770 deer were live-trapped and transplanted by the Texas Game and Fish Commission. The highest number taken was in 1947–48 when 1693 were removed. Most of these deer were put on Texas ranges, but releases have also been made in Oklahoma, Georgia, Florida, and the Virgin Islands.

The rut begins in September and reaches a peak in November. By March 1, most of the bucks have lost their antlers. First fawns are seen soon after the middle of April. First bucks with antlers out of the velvet are seen in August. Most bucks are out of the velvet stage by early September. Many deer are in the dark winter pelage by late September.

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DISTRIBUTION OF AND KEY TO THE NEOTENIC *EURYCEA* OF TEXAS

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ABSTRACT. Distribution of the neotenic *Eurycea* in Texas is confined to the Edwards Plateau. Locality records from Williamson and Val Verde counties represent the eastern and western extremes for the distribution of these forms. The Val Verde record is a southwestern range extension for the family Plethodontidae. Distribution of the five species of *Eurycea* from the plateau is discussed with new locality records given representing six new counties. A key is provided for the neotenic *Eurycea* in Texas.

INTRODUCTION

Distribution of the neotenic *Eurycea* in Texas is limited to certain of the springs and subterranean water courses along the maturely eroded Balcones Escarpment and adjacent areas on the Edwards Plateau, a massive upland extending over much of the central and southwestern parts of the state (see Fig. 1). Along the escarpment,

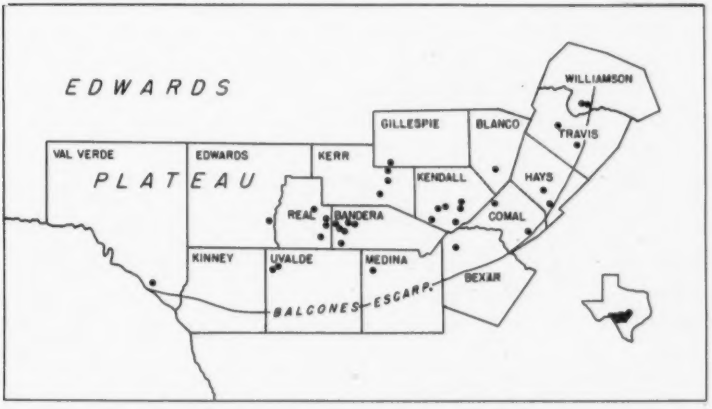

Figure 1. Localities of Neotenic *Eurycea* on the Edwards Plateau of Texas.

where thick strata of limestone are exposed and highly dissected, numerous springs and caves occur. Several of the larger springs are sources of rivers which flow to the lowlands south and east of the plateau. The escarpment arises just north of Austin, in Williamson

County, almost coincident with the northernmost *Eurycea* locality, and is at that point less than 100 feet in height. Extending southward to Bexar County, just north of San Antonio, the escarpment turns westward and reaches the Rio Grande at Del Rio, Val Verde County, where the plateau is several hundred feet in height. A cave north of Del Rio is the westernmost *Eurycea* locality.

DISCUSSION

It is unlikely neotenic *Eurycea* will be found in Texas in any area other than the plateau. The records in Williamson and Val Verde Counties are probably the eastern and western extremes for the distribution of these forms. The locality at Del Rio not only marks the western limit for the genus *Eurycea* but is the southernmost range extension in the United States for the family Plethodontidae. This helps bridge a gap in the distribution of the family from the forms in Texas with those in north central Mexico, and further investigation may show that *Eurycea* inhabits the springs and cave waters along the Sierra Madre in Coahuila, Mexico. The only other species of the Plethodontidae on the Edwards Plateau are *Plethodon glutinosus*, a terrestrial form which has not yet been found south or west of Real County, and *Typhlomolge rathbuni*, a neotenic, which is restricted to the subterranean waters in the vicinity of San Marcos, Hays County.

Five species of *Eurycea* are known now from the plateau: *Eurycea neotenes* Bishop and Wright; *Eurycea nana* Bishop; *Eurycea pterophila* Burger, Smith and Potter; *Eurycea latitans* Smith and Potter; and *Eurycea troglodytes* Baker.

Bishop and Wright (1937) described *Eurycea neotenes* and limited the distribution of the species to the type locality, Culebra Creek, Bexar County. Brown (1942) gave two range extensions for the species in Gillespie and Kerr Counties which extended the range approximately 50 miles in a north northwest direction from the type locality. Bishop (1943) listed a new locality from a cave near Boerne, Kendall County. Brown (1950) listed new localities from Bexar, Hays, and Travis Counties and gave the range of the species as from Bexar County, north and west to Travis and Kerr Counties.

Bishop (1941) described *Eurycea nana* and limited the distribution of the species to the type locality, the Comal Springs, San Marcos, Hays County.

Smith and Potter (1946) renamed Bishop's Boerne cave forms as *Eurycea latitans* and limited the distribution of the species to the Cascade Caverns, Kendall County. Milstead (1951) listed a new locality

for *Eurycea latitans* from a tributary of Turtle Creek, west of Kerrville, Kerr County. (It is in the opinion of the author that *Eurycea latitans* is restricted only to Kendall County in an underground water course that probably connects four caves: Dead Man's Cave, Cave Without A Name, Cascade Caverns, and Cascade Sinkhole. The record at Turtle Creek is 35 miles distant and the one specimen collected is probably not *Eurycea latitans*.)

Burger, Smith, and Potter (1950) described *Eurycea pterophila* and limited the distribution of the species to the type locality, 6.3 miles northeast of Wimberley, Hays County.

Baker (1957) described *Eurycea troglodytes* and limited the distribution of the species to the type locality, the Valdina Farms Sinkhole, Valdina Farms, Medina County.

Schmidt (1953) gave the range of the neotenic *Eurycea* as from springs along the Edwards Plateau escarpment and indicated a range of the known species at that time from three counties only: Hays, Kendall, and Bexar. These border on the easternmost part of the plateau. Conant (1958) described the distribution of *Eurycea* as from numerous localities in the vicinities of Austin and San Antonio to Edwards and Uvalde Counties.

Summarizing, the distribution of the neotenic *Eurycea* in Texas, as recorded in the literature, occupies nine counties: Hays, Kendall, Edwards, Bexar, Kerr, Gillespie, Travis, Uvalde, and Medina. In this paper, the author wishes to include additional records for *Eurycea neotenes* from six counties and extend the range for the species westward to Val Verde County and northward to Williamson County, Texas. The majority of specimens collected have been preserved in the University of Texas Natural History Collection.

Bandera County: 23 miles northwest of Medina, A. G. Flury; 18 miles northwest of Medina, W. F. Blair and W. A. Thornton; 5 miles northeast of Vanderpool, (collector unknown); 8 miles northeast of Utopia, C. Hubbs and K. Strawn; 8 miles north of Vanderpool, (collector unknown); 7 miles east of Vanderpool, K. Strawn. *Blanco County:* ¼ and ¾ mile southeast of Blanco, J. K. Baker and F. E. Potter, Jr. *Comal County:* Comal Springs in Landa Park, New Braunfels, A. G. Flury; cave on Plumbly Ranch, Spring Branch, J. K. Baker and F. E. Potter, Jr.

Edwards County: 4 miles northwest of Pulliam Creek, Barksdale, (collector unknown). *Kendall County:* 5 miles north of Boerne, 5 miles west northwest of Boerne on W. M. Thornton Ranch, 8 miles west of Boerne on Hall Ranch, F. E. Potter, Jr. *Kerr County:* 5 miles west of

Kerrville, Turtle Creek, C. Hubbs. *Real County:* 7 miles east and 4 miles south of Leakey, C. Hubbs and K. Strawn; 10 miles northeast of Leakey, East Frio River, C. Hubbs and K. Strawn; 10 miles northeast of Leakey, Cypress Creek, H. Lindsay and K. Strawn; 15 miles north of Leakey, Moffit Ranch, J. K. Baker. *Travis County:* spring in vicinity of Marshall Ford Dam, J. K. Baker. *Uvalde County:* Montell Springs at Montell, C. Hubbs; Montell Creek, Miller and Wells. *Val Verde County:* 3½ miles north of Del Rio, Four Mile Cave, J. K. Baker and W. McAlister. *Williamson County:* 3 miles northwest and 1½ miles northeast of Round Rock, Brushy Creek, A. G. Flury.

Since the neotenic *Eurycea* are now confined to allopatric distributions, it is not too difficult to arrive at a specimen's classification if its locality is known. *Eurycea nana*, *Eurycea pterophila*, and *Eurycea troglodytes* are restricted to one locality each and *Eurycea latitans* to four. This leaves only *Eurycea neotenes* for the numerous other recorded localities. Specimens taken from springs and cave waters, not type localities of other species, are referred to usually as being *Eurycea neotenes* since this form is the type species for the Edwards Plateau *Eurycea* complex. However, there are numerous morphological variations in nearly all these allopatric populations and many populations referred to now as *Eurycea neotenes* may be found later to warrant their own specific recognitions.

There are probably few amphibians more difficult to key than are the variable neotenic *Eurycea*. An up-to-date key for these forms is furnished herein which has been elaborated upon over other keys and may help make classification of the neotenic *Eurycea* more certain, but no less difficult.

KEY TO THE EDWARDS PLATEAU SPECIES OF NEOTENIC EURYCEA

1. Costal Grooves 15 or more. If 15, head not abruptly elevated from snout. Premaxillary teeth 12 or less. Eyes usually well developed (cave populations may have reduced eyes) and never covered with skin growth so as to be hidden in a dorsal view. Eye diameter usually 1.0 mm. or more (cave populations may have a diameter of less than 1.0 mm.). Eye diameter enters into interorbital distance 1–3 times. 2

1′. Costal Grooves 15 or less. If 15, head abruptly elevated from snout. Premaxillary teeth 18 or more. Eyes reduced and covered by skin growth so as to be hidden in a dorsal view or only slightly exposed. Eye diameter 1.0 mm. or less and

will enter 3–7 times into interorbital distance. 3

2. Costal Grooves 16–17. Small in size and slender; sexually mature individuals 50.0 mm. or less in length. Sclerotic coat quite apparent and distinguishable from pigmentation of surrounding skin and forming a dark ring around the lens. Eye diameter enters into interorbital distance 1–1½ times. Costal grooves between adpressed limbs 6–7. Pterygoid teeth 2–6. Restricted to area of Comal Springs, San Marcos, Hays County, Texas. .....*Eurycea nana*

2′. Costal Grooves 15–16. Medium in size and stout; sexually mature individuals more than 50.0 mm. in length. Sclerotic coat apparent but not well defined and partially hidden by pigment of surrounding skin. Eye diameter enters into interorbital distance 1–3 times. Costal grooves between adpressed limbs 5–6. Pterygoid teeth more than 6. 4

3. Costal Grooves 14. Eyes covered by a skin growth so as to be either completely hidden in a dorsal view or only slightly exposed. Eye diameter less than 1.0 mm. and enters 5–7 times into interorbital distance. Legs 5–11 times longer than broad. Premaxillary teeth about 24. Costal grooves between adpressed limbs about 2 (0–4); digits of fore and hind limbs may touch. Maximum length 78 mm. Forehead not abruptly elevated from snout. Restricted to Valdina Farms Sinkhole, Medina County, Texas. .....*Eurycea troglodytes*

3′. Costal grooves usually 15. Eyes not completely hidden in a dorsal view by a growth of skin. Eye diameter greater than 1.0 mm. and enter 3–4 times into interorbital distance. Legs 3–4 times longer than broad. Premaxillary teeth about 18. Costal grooves between adpressed limbs 4; digits of fore and hind limbs never touch. Maximum length 105 mm. Forehead abruptly elevated from snout. Restricted to caves near Boerne, Kendall County, Texas. .....*Eurycea latitans*

4. Posterior basibranchium present and Y-shaped. Last rib articulation simple. Tuberculum of penultimate rib ½ length of capitulum. Restricted to Fern Bank Springs, Wimberley, Hays County, Texas. .....*Eurycea pterophila*

4′. Posterior basibranchium absent. Last rib articulation differentiated into capitulum and tuberculum. Capitulum and tuberculum of penultimate rib of equal length. Distributed along Balcones Escarpment and adjacent areas of Edwards Plateau. .....*Eurycea neotenes*

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THE REDISCOVERY OF THE WATER SNAKE, *NATRIX HARTERI*, IN WESTERN TEXAS, WITH THE DESCRIPTION OF A NEW SUBSPECIES

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ABSTRACT. A population of *Natrix harteri* is reported from the Colorado River in Coke County, Texas. Comparison with a large series of specimens from the type locality and nearby stations along the Brazos River in Palo Pinto County, Texas, indicates that the Coke County population is subspecifically distinct. The new race is named herein, and data are presented for the first time on the extent of variation in *Natrix harteri* based on a study of more than 200 specimens.

Although *Natrix harteri* was described 20 years ago (Trapido, 1941) from the Brazos River seven miles north of Palo Pinto, Texas, and it subsequently has been found in abundance at the same locality by several herpetologists, specimens from other collecting stations have been few. Philip Harter, for whom the species was named, obtained series from Chick Bend and Fortune Bend, both upstream from the type locality, and Tinkle took one specimen just below the Possum Kingdom Dam which impounds the Brazos River ten miles northwest of Palo Pinto. Marr (1944, p. 486) reported two specimens from near Christoval on the South Fork of the Concho River, a tributary of the Colorado River, Tom Green County, Texas. Floyd E. Potter, Jr., obtained another specimen from the Colorado River drainage in Dove Creek, one mile west of Knickerbocker, Tom Green County, on November 29, 1947.

Recently one of us (Tinkle) found *Natrix harteri* to be abundant in the upper Colorado River at Robert Lee, Coke County, Texas. Collections totalling 114 specimens were made there on August 4 and 11, and October 8, 1960. Most of these are preserved in the zoology research collections of Texas Technological College. The other specimens have been distributed among a number of institutions, and these are enumerated under the heading "paratypes" below.

The localities from the Brazos River are separated from the group of stations in the Colorado River drainage by approximately 140 miles. Much of the intervening area is unsuited as a habitat for a semiaquatic animal, but, conversely, *Natrix harteri* has not been found in many apparently ecologically suitable localities in the two stream

systems. For these reasons, it is assumed that the two populations are isolated from gene exchange, primarily by extrinsic barriers.

Since the large sample from the Colorado River obviously was not identical with a much smaller series from the Brazos available to Tinkle, a detailed comparison of all available material was indicated. Conant, therefore, was invited to participate in the study because of his somewhat greater experience with *Natrix* and because he could contribute data from sizable samples of *Natrix harteri* from several Brazos River stations.

Natrix harteri **paucimaculata, ssp. nov.**

HOLOTYPE. AMNH 85542, an adult ♂, collected October 8, 1960, by Donald W. Tinkle and Don L. McGregor.

TYPE LOCALITY. The Colorado River south of the city limits of Robert Lee, Coke County, Texas.

PARATYPES. AMNH 85543–51; ANSP 26669–70; CM 37533–4; CNHM 128310–11; UF 14906.1–2; KU 59884–5; MCZ 56991–2; TU 17616–7; UIMNH 49336–7; UMMZ 121691–2; and USNM 142806–7. All paratypes were collected at the same time and place as the holotype. An explanation of the initials for the various museum collections will be found under the heading of "material studied" (below).

DIAGNOSIS. A water snake of moderate dimensions, similar in pattern and scutellation to *Natrix harteri harteri* of the Brazos River, but differing in the following characteristics: (1) the dark circular spots on the belly absent or greatly reduced in size, number, and intensity of pigmentation; (2) females with a reduced number of subcaudals (mean 68.6, range 64 to 71, compared with 73.0, range 67 to 79, in subspecies *harteri*); (3) the gular scales between the posterior chin shields almost invariably reduced to one row instead of two; and (4) the postoculars almost always 6 (both sides lumped together) rather than four or five.

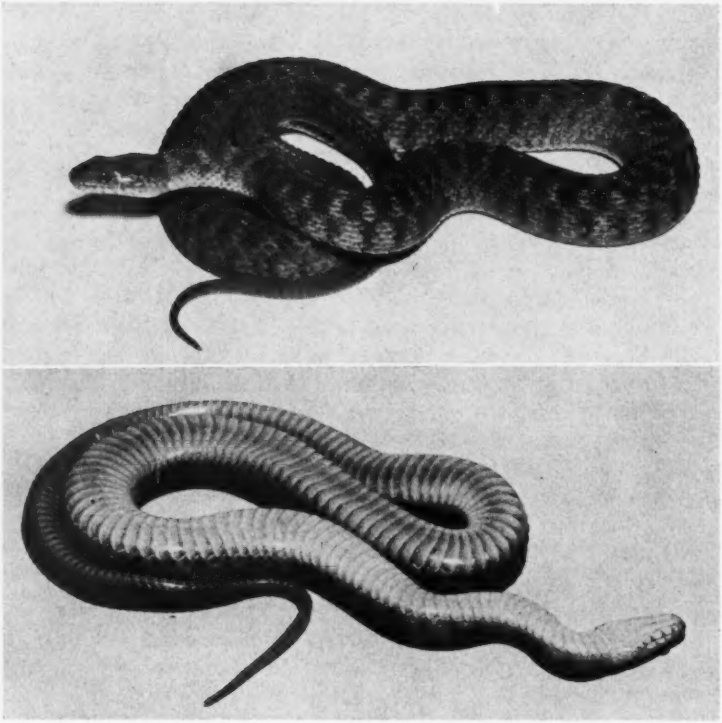
The presence of four longitudinal rows of dark dorsal spots will distinguish the two races of *Natrix harteri* from all other North American *Natrix* with the exception of *Natrix kirtlandi* of the Prairie Peninsula and adjacent regions of the Midwest. *Natrix kirtlandi* has a maximum of 19 scale rows at midbody (21 to 23 in *harteri*) and a low number of ventrals, subcaudals, labials, etc. (for details see Conant, 1943).

DESCRIPTION OF HOLOTYPE (Figs. 1 and 2). Cephalic scutellation as described for the type of *Natrix harteri* [*harteri*] (Trapido, *op. cit.*, p. 674) except where noted below. Frontal somewhat abnormal, its posterior border slightly notched on both the left and right sides

where they meet the corresponding parietals. Two nasals, the anterior bearing the nostril within it. Loreal slightly larger in area than the posterior nasal. Two preoculars on the left and one on the right, in contact with the 3rd and 4th upper labials. Three postoculars on both sides. One temporal in the first row and two in the second, the lower posterior temporal in contact with the 7th and 8th upper labials. Eight upper labials, the 6th the largest, the 4th and 5th entering the orbit on the left; only the 4th enters on the right, the 5th being cut off from the eye by the lowermost postocular. Ten lower labials, the 5th and 6th the largest. Posterior chin shields separated by three small scales arranged in a single row. Ventrals 147, including one on the throat that is shorter (in transverse axis of body) than the other ventrals. A small "half ventral" wedged in between the terminal ventral and the anal plate on the right side of the belly. Anal divided. Subcaudals in 80 pairs, the tail terminated by a very short, sharp scale. Dorsal scale formula 21–23–21–19–17; all rows carinate; paired apical pits present. Total length 652 mm.; tail length 173 mm.; tail length 27% of total length.

All colors mentioned in the following description were recorded in life shortly after the holotype had cast its skin. Capitalized color names are in accordance with Ridgway (1912).

General dorsal coloration light brown, the ground color between the blotches with a pinkish tinge (Sayal Brown to Cinnamon). Dorsal pattern consisting of 4 parallel rows of dark blotches on a lighter ground color. Blotches of the 2 middorsal rows medium brown (Saccardo's Umber), rounded, 2 scales in width on the anterior part of body but narrowing to 1 scale on and near the tail; blotches extend laterally to the 7th or 8th row of scales anteriorly and to the 6th near the tail. Blotches separate or irregularly fused with their partners of the adjoining row, often forming saddles that may run straight or diagonally across the midline of the back; 67 blotches on the left and 64 on the right side of the body, counting from the head to a point directly above the anus. Lateral blotches pinker (Pecan Brown), considerably narrower than dorsal ones, involving only a fraction of a scale in width but extending from the 1st to the 5th row of scales on the neck, the 2nd to the 5th throughout most of the length of the body, and the 2nd to 4th near the tail. The lateral blotches become most prominent when the skin is stretched, revealing black pigment on the skin between the scales within the area encompassed by the blotches. All four rows of blotches continue onto the tail, but become smaller and virtually disappear on the posterior third. General dorsal coloration of tail medium brown (Snuff Brown).



Figs. 1 and 2. *Natrix harteri paucimaculata*. Holotype (AMNH 85542) from the Colorado River, Robert Lee, Coke County, Texas, October 8, 1960. Total length 652 mm.; ♂. Fig. 1. Dorsal view. Fig. 2. Ventral view showing virtual absence of dark markings on the belly.

Top of the head virtually plain medium brown (Saccardo's Umber) except that the edges of the scales are paler. A small, blackish spot near the anterior corner of each parietal. Sutures of labials edged with Cinnamon-Rufous. Chin and throat cream-colored, gradually changing posteriorly to Cinnamon-Buff. Center of belly with a broad wash of medium orange (Apricot Orange). Under side of tail paler (Apricot Buff). The belly is virtually unmarked except for a few very small dark spots near the anterolateral corners of a few of the ventrals. One such spot appears on the 64th ventral and another on the 81st; posteriorly there are several others mostly smaller and fainter. Additional very small dark spots can be found under the edges of some of the ventrals by bending the snake out of its normal circular (preserved) position. Subcaudals conspicuously marked, except near tail tip, by

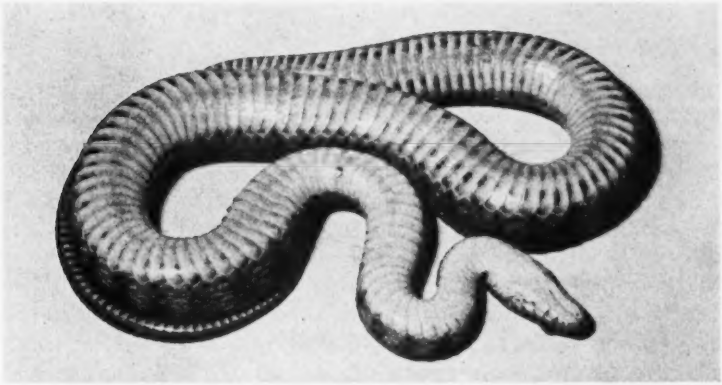


Fig. 3. *Natrix harteri harteri*. (AMNH 85336) From Fortune Bend of the Brazos River, 6 miles west northwest of Palo Pinto, Palo Pinto County, Texas, July 4, 1951. Total length 738 mm., ♀. Ventral view showing pairs of dark markings on the ventral scutes. All photographs by Isabelle Hunt Conant.

black spots or stippling concentrated upon the antero-central portion of each scute.

MATERIAL STUDIED. The relatively large samples of both *paucimaculata* (117 specimens) and subspecies *harteri* (96 specimens) that have been available to us make it possible to present a detailed review of variation in both races, and to make comparisons between them. The summarizations and analyses that follow are based upon the specimens listed below, plus the holotype and paratypes. All localities are in Texas. Figures in parentheses indicate numbers of specimens.

Natrix harteri harteri

Seven miles north of Palo Pinto (*type locality*)—AMNH 63933, 64408–12, 85099–121, 85314–27, 85346–53; ANSP 26667–8; TTC 1729(5), 2036(8), 2252(2); private collection of A. G. Flury, nos. 1190–91. *Chick Bend of Brazos River*, 4 miles northwest of Palo Pinto—AMNH 72685–90. *Fortune Bend of Brazos River*, 6 miles west northwest of Palo Pinto—AMNH 85328–45. *Possum Kingdom Dam*, 10 miles northwest of Palo Pinto—TTC 2265.

(All specimens of subspecies *harteri* are from Palo Pinto County.)

Natrix harteri paucimaculata

Robert Lee, Coke County (*type locality*)—TTC 2029(14), 2110 (56), 2220(14). *South Fork of the Concho River* near Christoval, Tom Green County—SNHM 9896–7. *Dove Creek*, 1 mile west of

Knickerbocker, Tom Green County—private collection of Floyd E. Potter, Jr., no. 370.

The initials used above and in the list of paratypes refer to the following institutions: Academy of Natural Sciences of Philadelphia (ANSP), American Museum of Natural History (AMNH), Carnegie Museum (CM), Chicago Natural History Museum (CNHM), University of Florida (UF), Museum of Comparative Zoology (MCZ), Stanford University Natural History Museum (SNHM), Texas Technological College (TTC), Tulane University (TU), United States National Museum (USNM), University of Illinois Museum of Natural History (UIMNH), University of Kansas Museum of Natural History (KU), and University of Michigan Museum of Zoology (UMMZ).

COLOR PATTERN. The most conspicuous difference in the two races is the lightly marked or virtually immaculate belly of *paucimaculata* compared with the relatively strongly-spotted undersurface of *harteri*. Spots, when present in *paucimaculata*, are usually small and indistinct; often they lie so far forward on the ventral scute that they are hidden by the overlapping edge of the scute immediately preceding. An attempt was made to evaluate the extent of the ventral spotting by classifying individual snakes as having (a) virtually none, (b) a few to numerous spots, and (c) many (= strongly spotted). Among 113 *paucimaculata*, 84% had virtually none; among 91 *harteri*, 97% were strongly spotted. Many individuals of both races have a wash of bright pigment extending down the center of the venter, and this is most distinct posteriorly; in *paucimaculata* the tone is usually tan or pale orange, whereas in *harteri* it is usually pink or rose-colored.

The dorsal pattern of the two races is identical, but the ground color in *paucimaculata* is generally paler and more reddish than in *harteri*. The number of blotches is more variable in *paucimaculata*. Among 112 specimens of the latter there are 44 to 69, mean 58, blotches in the left paravertebral row, counting from the back of the head to a point directly above the anus. The corresponding figures for 88 *harteri* are 52 to 67, mean 61. In both races there is frequently a difference of two or three blotches in the counts on opposite sides of the body. It is also characteristic of both races to have the dorsal blotches irregularly arranged. Usually they alternate to form a more-or-less checkerboard pattern, but sometimes the blotches are directly opposite those of adjacent rows or they may be fused with their partners across the back to form transverse saddles.

SCUTELLATION. The scale differences that are taxonomically use-

ful, viz. rows of scales between posterior chin shields, oculars, and subcaudals are discussed first.

GULAR SCALES. Among 84 *harteri* in which this character was recorded, 43% have one row of gular scales between the posterior chin shields and 57% have two rows. Among 112 *paucimaculata*, 1% have no gular scales and 1% have two rows, whereas 98% have a single row.

POSTOCULARS. In 93 *harteri* in which postoculars can be counted, 71% have five or less and 29% have six or more (counts for both sides lumped together). In 116 *paucimaculata* only 4% of the individuals have five or fewer scales, whereas 96% have six or more. Unequal counts on the two sides are frequent. The most common arrangement in *paucimaculata* is 3–3; in *harteri* it is 2–2 or 3–2.

SUBCAUDALS. The subcaudals are more strongly subject to geographic variation in females than in males; there is little difference in this character in males. Thirty-four *harteri* females vary from 67 to 79, with a mean of 73.0 ± .52. The range of variation in 53 female *paucimaculata* is from 64 to 74, with a mean of 68.5 ± .29. On the basis of this character, about 80% of the individual females of *harteri* can be separated from a like percentage of *paucimaculata* (coefficient of diff. = .87). Fifty-two males of *harteri* vary from 76 to 88 (mean 81.8 ± .35); 51 male *paucimaculata* vary from 77 to 83 (mean 80.0 ± .22). Whereas the sample sizes of the males are nearly equal, it might seem that the apparent difference in the number of subcaudals in females could be the result of an inadequate number of female *harteri*. This is not the case, however, because the larger sample of *paucimaculata* exhibits a narrower range of variation than the smaller one of *harteri*. Hence, there is no evidence of sample bias in the mean differences in subcaudal counts found by us, nor is there bias based upon age groups. About twice as many young females of *harteri* (15) were examined as of *paucimaculata* (7). In both races the mean for the young is higher than for the entire sample.

Both subspecies show strong sexual dimorphism in subcaudal scale counts, but the difference is greater in *paucimaculata* than in *harteri*. The variability in both male and female *harteri* is greater than in *paucimaculata*. The coefficients of variability for this character in the two races is as follows:

	harteri	*paucimaculata*
Males	3.1	1.9
Females	4.2	3.1

Other explanations are possible, but this difference may indicate stronger selection pressure in the *paucimaculata* population.

VENTRALS. There is little difference in ventral scale counts in the two races, but *paucimaculata* is slightly more variable because of three individuals with somewhat lower (aberrant?) numbers of ventrals. Except for these three with counts of 139, 141, and 142, respectively, the remaining 111 individuals vary from 144 to 151 (mean 147.8 ± .15). There are no apparent aberrant counts among 94 *harteri*, which vary from 143 to 151 (mean 147.0 ± .17).

DORSAL SCALE ROWS. At least four, and in most instances five or more, dorsal scale counts were made on each snake in an effort to be certain that both minimum and maximum numbers were included. There are only minor differences in the two races, the principal one being that the preanal scale count is 16 in 85% of the *harteri*, but in only 57% of the *paucimaculata*. The comparative figures for numbers of dorsal scales in the neck, midbody, and preanal regions are shown in table 1.

TABLE 1

Numbers of dorsal scale rows at neck, midbody, and preanal regions in two races of Natrix harteri. Figures in parentheses are percentages; others are numbers of specimens examined.

Region	Rows	*harteri*	*paucimaculata*
Neck	21	70(74)	80(71)
	22	8(9)	19(17)
	23	16(17)	13(12)
Midbody	19	7(8)	0
	21	67(73)	72(62)
	22	3(3)	14(12)
	23	15(16)	30(26)
Preanal	15	0	4(3)
	16	80(85)	67(57)
	17	14(15)	45(39)
	18	0	1(1)

SUPRALABIALS. Most specimens of both races have 8 supralabials on both sides of the head for a total of 16. This is the case in 97% of 94 specimens of *harteri* and 90% of 115 *paucimaculata*. There are 17 upper labials in 3% of *harteri* and 10% of *paucimaculata*.

INFRALABIALS. In both races most specimens have 10 lower labials on each side. Among 91 *harteri*, 3% have a total of 18 lower labials, 11% have 19, 83% have 20, and 3% have 21. Comparable figures for *paucimaculata* are 2%, 15% and 83% for 18, 19, and 20 infralabials, respectively.

PREOCULARS. In *harteri*, the preoculars are almost invariably one; among 89 specimens the count is one in all but a single snake which has two on one side of the head. The number of preoculars is more

variable in *paucimaculata;* among 114 specimens, 71% have one and 11% have two. Eighteen per cent of the individuals have one on one side and two on the other.

TEMPORALS. All *harteri* (94) have one anterior temporal; all *paucimaculata* (117) also have one, except for a single individual which has two on one side of the head. The posterior temporals are more variable and are often different on opposite sides of the head. Among 93 *harteri*, 26% have four, 45% have five, 28% have six, and 1% have seven (counts from both sides lumped together). The 117 *paucimaculata* differ significantly, since 14% have four, 32% have five, and 54% have six.

TAIL LENGTH/TOTAL LENGTH RATIO. Both races show remarkably little variation. Male *harteri* ratios vary from 25% to 29% (mean .27 ± .001) in 50 specimens, whereas male *paucimaculata* range from 24% to 28% (mean .26 ± .001) in 47 specimens. Although the difference is slight, it is highly significant because of the small amount of variability. The tail of male *paucimaculata* is significantly shorter, with 75% of the individuals having a tail 26% of the total length or less. In *harteri* only 24% have a tail 26% or less of the total length. A similar situation exists among the females with 34 *harteri* having a mean of .24 ± .002 and 50 *paucimaculata* one of .23 ± .001. Seventy per cent of female *harteri* have a tail length that is 24% of the total length or more, whereas this is true of only 32% of female *paucimaculata.*

In both races there is strong sexual dimorphism with about 90% separable by sex on the basis of relative tail length.

In neither race is there an obvious ontogenetic change; the ratios are virtually the same in both juveniles and adults.

DISCUSSION. In general there are differences in virtually all the scale characters studied, but most are of statistical rather than taxonomic significance. Even those characters which are not taxonomically useful, however, indicate differences in gene frequencies that would be expected in diverging races.

The color pattern differences will serve to separate the majority of one race from most of the other. Color pattern is a useful and widely employed character in distinguishing subspecies of *Natrix.* Compared with the degree of difference exhibited by races among several other species of *Natrix*, the dissimilarity between *harteri* and *paucimaculata* is at least as great. In addition there is about 80% non-overlap in the caudal scale counts of females of the two subspecies and important

differences in postoculars, gular scales, and other generally conservative characteristics.

RANGE. The ranges of *harteri* and *paucimaculata* as they are known at present, indicate extreme ecological and geographical restriction compared with most other water snakes. The reasons for such restriction, if real, are not apparent. Many other localities in the Brazos drainage have been investigated with negative results. Tinkle has done field work in most of the major tributaries of the upper Colorado and Concho Rivers, particularly the former, and also with negative results. It would seem that the restricted distribution is real and that (geographically) intermediate populations between *harteri* and *paucimaculata* probably do not exist. The reasons for the restriction of these two races to the upper portions and tributaries of two major river systems are not clear. It could be attributed to periods of great aridity that occurred in these areas in the past. This might explain their isolation in two separate drainages, but it would not explain why they do not occur farther downstream in their respective rivers. In both localities where these snakes occur abundantly, no other semi-aquatic snake is very numerous in the same micro-habitat except *Thamnophis sauritus*, so competition with other species of *Natrix* may have played an important role in the present distribution. Another factor may be that the deeper, more sluggish, and silt-burdened downstream portions of the rivers may not provide suitable habitats. Both races of *harteri* are apparently quite restricted in their requirements (see below).

HABITAT. The part of the Brazos River, where *harteri* has been taken in large numbers, is a swift, rocky stream with periodic sandbars. This subspecies is most frequently found under rocks along the water's edge or on bushes and in grasses along the shore. Its ability to swim in swift water is remarkable.

At Robert Lee, in Coke County, the type locality of *paucimaculata*, the Colorado River is a sluggish stream that, save in times of flood, is seldom more than a foot deep except in isolated pools scattered throughout the five miles of the river that have been investigated. All *paucimaculata* were taken under rocks, usually those on the sand bars, or they were swimming in the shallow pools. They were seldom seen in or along the deep pools, although other *Natrix* may be abundant there. The Colorado River in this area flows across a limestone bed in an area of exposed Permian red beds. The surrounding areas are badly overgrazed mesquite grassland. Unlike the Brazos locality, there are few trees to shade the water, and the habitat is much less mesic and more exposed.

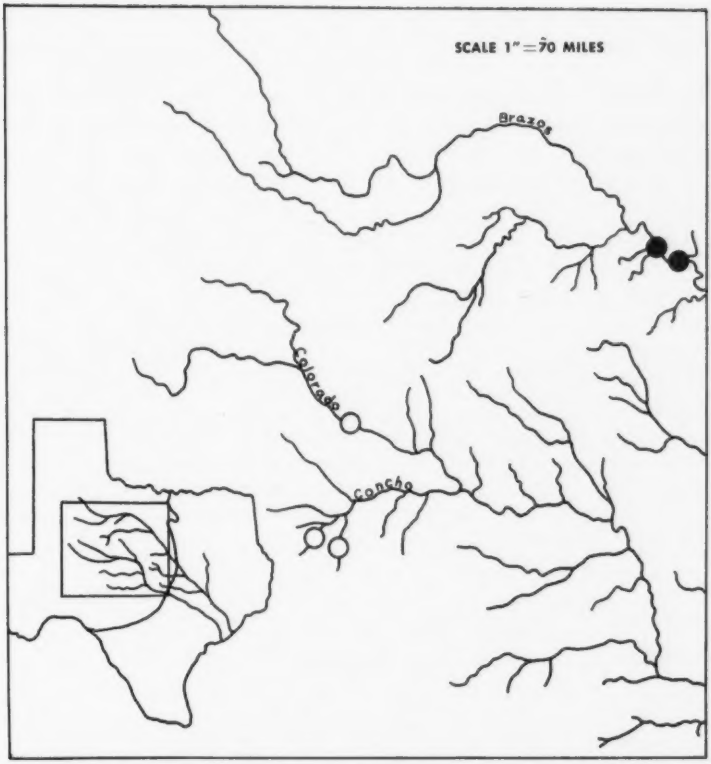


Fig. 4. Small inset at bottom left is map of Texas showing position of the inland margin of the coastal plain and the general courses of the Brazos and Colorado rivers. The square block outlined in the inset is enlarged to show details of the upper Brazos and Colorado river drainages and the localities from which *Natrix harteri harteri* (solid circles) and *Natrix harteri paucimaculata* (open circles) have been taken.

In addition to *paucimaculata*, 10 *Natrix rhombifera rhombifera*, 8 *Natrix erythrogaster transversa*, 15 *Thamnophis sauritus proximus*, and 2 *Thamnophis marcianus marcianus* were taken at the Coke County locality. *Natrix erythrogaster* is probably much more common than the sample would indicate, because it is most abundant in and around the deep pools where collecting is difficult.

ACKNOWLEDGMENTS

We are indebted to the following students for their help in the field and laboratory; Sumner Dana, Don Woodard, Dan McGregor, Don

McGregor, Irving Patterson, and Jerry Gerald. Philip Harter obtained many specimens over a period of several years from localities along the Brazos River. Thanks must also be extended to Charles M. Bogert, Alvin G. Flury, John C. Marr, Floyd E. Potter, Jr., and the late Margaret Storey for the loan of specimens and for assistance in various other ways.

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NOTES

MEIOTIC CHROMOSOMES IN SIX TEXAS AND MEXICAN NEMASTYLIS AND SISYRINCHIUM (IRIDACEAE).—Bowden (Am. Jour. Bot. **32**: 91, 1945) reported the chromosome numbers for nine species of *Sisyrinchium* which he found distributed in two groups with basic numbers of 8 and 9. Diploid to high polyploid species were differentiated in each series. Other workers have increased the cytologically known taxa to thirteen. One Hawaiian species, *S. acra* Mann (Skottsberg, Ark. Bot. **3**: 69, 1953) with $2n = 34$, introduces a third series of $x = 17$ chromosomes possibly originating as an amphidiploid from species of the 8 and 9 series.

Immature flower buds of both genera were fixed in a solution of 4 parts chloroform, 3 parts absolute ethyl alcohol, and 1 part glacial aectic acid, and after storage at refrigerator temperature the buds were squashed in 1% acetic-orcein. The meiotic chromosomes were studied from P.M.C.'s and drawn with the aid of a camera lucida at X 2350. Voucher specimens are deposited for each collection in our herbarium (ASTC).

One species of *Nemastylis* and five species of *Sisyrinchium* have been examined cytologically. These include:

Figures 1–6. Meiotic chromosomes of *Nemastylis* and *Sisyrinchium*. Fig. 1—*N. purpurea* (n=14). Fig. 2—*S. ensigerum* (n=16). Fig. 3—*S. langloisii* (n=16). Fig. 4—*S. micranthum* (n=16). Fig. 5—*S. pruinosum* (n=16). Fig. 6—*S.* cf. *quadrangulatum* (n=16) (with sticky chromosomes). 2350 X, reduced approximately one-third in reproduction.

N. purpurea Herbert **n = 14, 2n = 28** (Fig. 1).
Texas: Nacogdoches Co., 3.5 miles south of Nacogdoches, *Lewis 5238*.
S. ensigerum Bicknell **n = 16** (Fig. 2).
Texas: Brewster Co., 19.6 miles south of Alpine, *Lewis & Oliver 5439*.
S. langloisii Greene **n = 16** (Fig. 3).
Texas: Angelina Co., Angelina River & Hwy. 59, *Oliver 116*.
S. langloisii Greene **n = 16**.
Texas: Trinity Co., 1.1 miles west of Neches River & Hwy. 94, *Oliver 117*.
S. micranthum Cav. **n = 16** (Fig. 4).
Texas: Trinity Co., 1.1 miles west of Neches River & Hwy. 94, *Oliver 118*.
S. pruinosum Bicknell **n = 16** (Fig. 5).
Texas: Dallas Co., 3235 Arizona Ave., Dallas, *Oliver 115*.
S. cf.*quadrangulatum* Klatt **n = 16** (Fig. 6).
Mexico: Districto Federal, 20.6 miles south of Tlalpan, *Oliver 180*.

The counts of 14 meiotic and 28 somatic chromosomes for *N. purpurea* are the first reports for the genus. The two large bivalents found in each meiotic plate (Fig. 1) and the two pairs of large chromosomes in the mitotic configurations were about three times the size of the average bivalent and chromosome. All species of *Sisyrinchium* were found with 16 haploid chromosomes representing tetraploids in the $x = 8$ series. It is not unlikely that some gene exchange is possible between these unibasic taxa as has been suggested for *S. ensigerum*, *S. langloisii*, and *S. pruinosum* on morphological evidence (Shinners, Spring Flora Dallas-Fort Worth Area Texas, 100–102, 1958).

Meiosis in the *Sisyrinchium* collections was generally regular; however, a degree of "stickiness" between chromosomes was observed in the P.M.C.'s of three collections, *S. langloisii*, *S. micranthum*, and *S. quadrangulatum* (Fig. 6). These buds were collected on the 23 April, 23 April, and 22 June, respectively, which in each area is somewhat past the peak of flowering and certainly beyond the time of maximum meiosis. In two collections made earlier in April, sticky chromosomes were not seen. This suggests that at certain times in the reproductive cycle of *Sisyrinchium*, changes take place in the meiotic cells causing this anomaly.

Since few species have been studied cytologically and morphologically in this comparatively large genus, it would be premature to suggest phylogenetic trends. We mention only that those taxa with the basic number of 8 are common in North America at the tetraploid level. One species, and this South American, is known to be diploid in this series and again, the three $x = 9$ diploids are South American in origin. Chromosomal studies on *Sisyrinchium* will be continued as material becomes available.

We are indebted to Dr. Lloyd H. Shinners, S. M. U., for his verifications of *Sisyrinchium* and to the National Science Foundation (G12059) for support of the second author as an Undergraduate Research Participant during the summer of 1960.—*Walter H. Lewis and Royce L. Oliver, Stephen F. Austin State College, Nacogdoches, Texas.*

CHROMOSOME NUMBERS FOR FOUR NORTH AMERICAN ASCLEPIAS. —The chromosome numbers for eight species of *Asclepias* have been reported by Moyer (Bot. Gaz. **97:** 860, 1936) and by Moore (Canad. Jour. Res. **24C:** 66, 1946) as $n = 11$ or $2n = 22$. All are included in the subgenus *Asclepias* (Woodson, Ann. Mo. Bot. Gard. **41:** 1–211, 1954). From these data Woodson suggests that the evolution of the milkweeds has been along lines other than by aneuploidy and polyploidy. Since the available information is only for the more closely related species,

it seemed expedient to count the chromosomes for the morphologically more diverse. Below are listed the collection data and results for species now included in the subgenera *Asclepias* (1–2), *Asclepiodora* (3), and *Podostemma* (4).

1. *A. curassavica* L. **2n = 22**. Mexico: Hidalgo, 4 miles southwest of Taman, *Lewis 5383*.

2 *A. verticellata* L. **2n = 22**. Louisiana: Natchitoches Par., Natchitoches, *Lewis 5248*.

3. *A. asperula var. decumbens* (Nutt.) Shinners **2n = 22**. Texas: Fayette Co., 2.3 miles south of Round Top, *Lewis 5176*.

4. *A. subulata* Dcne. **2n = 22**. Mexico: Baja California Sur, 1.4 km. west of San Jose del Capo, *Lewis 5342*.

In support of Woodson, these counts do not suggest that major chromosomal changes have contributed to speciation in the genus.—*Walter H. Lewis, Stephen F. Austin State College, Nacogdoches, Texas.*

CHROMOSOME NUMBERS FOR FIVE AMERICAN SPECIES OF CALLICARPA, LANTANA, AND PHYLA (VERBENACEAE).—While collecting material for a chromosomal study of the American species of *Verbena*, representatives of three genera in the family were also collected and their meiotic chromosomes examined. As small as this sample is, it doubles the cytological data now available for these genera.

CALLICARPA. Of the many Asian species only *C. japonica* Thunb. has been studied

Fig. 1—*Callicarpa americana*, n=18. Fig. 2—*Lantana horrida*, n=22. Fig. 3—*Phyla incisa*, n=18. Fig. 4—*P. lanceolata*, n=18. Fig. 5—*P. strigulosa*, n=18. 2350 X.

with reports of $2n = 16$ and 18. *C. americana* L. has been found with $n = 18$ chromosomes from plants collected in Texas, Angelina Co., Redland (*Lewis & Oliver 5244*, Fig. 1) and Nacogdoches Co., Nacogdoches (*Lewis & Oliver 5232*). The correct number for *C. japonica* is probably $2n = 18$ with *C. americana* a tetraploid species in this $x = 9$ series.

LANTANA. To the basic number of $x = 11$ can be added the tetraploid *L. horrida* H.B.K. with $n = 22$ chromosomes. The plant from Texas, Kleberg Co., 1 mile west of Riviera (*Oliver 110*) had slightly irregular meiosis with 3_{I}, 19_{II}, and 1_{III} (Fig. 2).

PHYLA. The three species examined at meiosis include: (1) *P. incisa* Small, $n = 18$, from Texas at Dallas Co., Mountain Creek Lake (*Oliver 75*, Fig. 3) and Harris Co., Houston Medical Center (*Lewis 5302*); (2) *P. lanceolata* (Michx.) Greene, $n = 18$, from Texas, Nacogdoches Co., 3.9 miles west of Nacogdoches (*Oliver 88*, Fig. 4); and (3) *P. strigulosa* (Mart. & Gal.) Moldenke, $n = 18$, from Mexico, Tamaulipas, 3 miles west of Ciudad Mante (*Lewis 5389*, Fig. 5). These numbers are consistent with the previous count for *P. nodiflora* (L.) Greene.—*Walter H. Lewis, Stephen F. Austin State College, Nacogdoches, Texas.*

MEIOTIC CHROMOSOME NUMBERS FOR TWO SPECIES OF THE GENUS PSITTACANTHUS (LORANTHACEAE).—The genus *Psittacanthus* is composed of approximately 50 species found in tropical and subtropical America. All are parasites, usually upon dicotyledonous plants such as *Persea, Acacia, Prosopis, Quercus, Prunus* and others.

Chromosome counts were made from pollen mother cell squashes in the same method used by Turner (1960, Southwestern Naturalist 5: 12–15). Voucher specimens are deposited in the Herbarium of The University of Texas.

Figures 1–2. Camera lucida drawings of (Metaphase I) meiotic chromosomes of *Psittacanthus*. Fig. 1. *P. auriculatus* (n=10). Fig. 2. *P. calyculatus* (n=10). X ca. 1350.

The only other chromosome count reported for the genus was by Covas and Schnack (1946, Rev. Argentina Agron. 13: 153–166). They reported a number of $n = 10$ for a Peruvian species, *P. cuneifolius* Blume. As indicated by these authors,

the meiotic chromosomes of this genus are exceptional for their size, ranking among the largest in flowering plants (Figs. 1–2).

Chromosome counts from 7 populations (Table 1) are reported in the present paper including counts for two previously unreported species of the genus.—*Robert Merrill King, Herbarium, The University of Texas, Austin 12, Texas.*

TABLE 1

Species	Collection	*n* number
Psittacanthus auriculatus (Oliver) Eichl.	OAXACA: 3 miles southeast of Oaxaca. *King 3481.*	10
Psittacanthus auriculatus (Oliver) Eichl.	OAXACA: along route 125, *ca.* 16 miles southwest of the Oaxaca-Puebla border. *King 3546.*	10
Psittacanthus calyculatus (D.C.) Don	CHIAPAS: 10 miles south of Las Cruces. *King 3438.*	10
Psittacanthus calyculatus (D.C.) Don	PUEBLA: 2 miles south of Tehuacan. *King 3550.*	10
Psittacanthus calyculatus (D.C.) Don	CHIAPAS: 14 miles north of Suchiate. *King 3432.*	10
Psittacanthus calyculatus (D.C.) Don	OAXACA: one mile east of Niltepec. *King 3450.*	10
Psittacanthus calyculatus (D.C.) Don	MICHOACAN: along route 15, *ca.* 11 miles west of the Michoacan-Mexico border. *King 3601.*	10

ATRIPLEX KLEBERGORUM (CHENOPODIACEAE), NEW SPECIES.—Planta herbacea annua farinosa diffusa 15–30 cm alt., folis ramisque alternis; folia sessilia crebra, ca. 1 cm longa, ovato-deltoidea ad basim latissima, integra. Flores monoecii sessiles axillares; flores staminei singulares ca. 2 mm lat., 5 sepala elliptica hyalina atque 5 antheras magnas sepalis oppositias habentes; flores pistillati bractiis ab ovario non separabilibus praediti, flore toto velut structura aliquantulum planata ovato-elliptica, ca. 15 mm long., 2 stylos filiformes habente solummodo viso. Fructus indehiscens nuciformis; bracteae fertiles ovato-orbiculares, 4–6 mm diam. circum margines diverse irregulater 3–7 fissae, in lateribus irregulariter inperspicue bis cristatae. Semen rotundato-lenticulare 1.5 mm diam., embryo periferali, radicula superiore.

Densely farinose diffuse annual herbs 15–30 cm tall; taproot ligneous, 5–9 mm thick, pale-barked, vertical, slenderly napiform, passing into the erect mainstem 3–7 mm thick; branches alternate, numerous, 15–40 cm long, somewhat more slender than mainstem, mostly horizontal or distally ascending, and bearing numerous slender ascending secondary branches; stems and branches terete, when young densely white-farinose, the older portions becoming glabrate and acquiring thin, flaky pale brownish white bark; internodes mostly shorter than 1 cm. LEAVES alternate, or the lowermost almost opposite, essentially sessile, crowded, estipulate, the larger ones 1 cm long, ovate-deltoid, widest at the base, apically acute (60–90° angle), basally truncate or even slightly clasping-cordate, marginally entire or seemingly erose or toothed mainly through insect-damage, rather firm and with no tendency to roll on drying, very densely canescent farinose with a greenish yellow tinge. FLOWERS unisexual, monoecious, sessile, axillary, very inconspicuous, mostly found in leafy lateral branches with extremely short internodes rising toward the tips of the secondary branches. STAMINATE FLOWERS solitary in the most distal axils,

ca. 2 mm across, of 5 curved, elliptic, mucronulate, mostly hyaline sepals, farinose dorsally and ca. 1.5 mm long, the 5 large anthers opposite the sepals and nearly filling the calyx on white filiform filaments 1–1.3 mm long. PISTILLATE FLOWERS densely farinose without, the bracts inseparable from the ovary, the whole appearing merely as a slightly flattened ovoid-elliptic structure ca. 1.5 mm long, with 2 brown filiform styles ca. 3 mm long diverging from the apical depression between the four "teeth." FRUIT indehiscent, nutlike; fruiting bracts densely and coarsely furfuraceous, ovate-orbicular, 4–6 mm in diameter, variably and irregularly 3–7-cleft around the margins (the divisions truncate), and irregularly and indistinctly doubly cristate laterally; seed round-lenticular, ca. 1.5 mm in diameter, dark shining reddish-brown; embryo disposed peripherally in an almost complete circle around the abundant white endosperm, the radicle always superior (i.e., the notch of the seed always points away from the receptacle). TYPE: Kleberg County, Texas, Laureles Divison of King Ranch, ca. 35 miles southeast of Kingsville near Alazan Bay, locally abundant, clay soil, *Fred B. Jones 2301* [with Clarence Cottam and Val Lehman], August 21, 1958 (SMU WELDER). The type does not show mature fruits; the characters of these were derived from another specimen, same county, ca. 4 miles southeast of Ricardo in silty soil, somewhat sloping, *Fred B. Jones 2458A*, September 29, 1958 (WELDER). I have seen two other collections both from Kleberg County: *J. F. Sinclair s.n.* (U. S. Natl. Herbarium); and Loyola Beach, *Fred B. Jones 3860* [with Chester Rowell] December 29, 1959 (WELDER). I have been unable to find any other plants in the United States National Herbarium or other herbaria with which this species could be identified, nor do any published descriptions agree with it's characters. It apparently would fall into the Section Argenteae of Standley (No. Amer. Flora 21: 34, etc., 1916).

Mr. Jones, of Corpus Christi, has made the finest and most complete collections of plants of the Coastal Bend during the last decade. He kindly made the specimens of this species available to me and suggested that the species be named after the Kleberg family, owners of the King Ranch of southern Texas, and supporters of scientific research on a large scale. It is with pleasure that I follow Mr. Jones' suggestion. The help and cooperation of Mr. Val Lehman, biologist for the King Ranch, is gratefully acknowledged by Mr. Jones. Mr. Jones and I would like to extend our thanks to Dr. Clarence Cottam, Director of the Welder Wildlife Foundation, Sinton, Texas, for his encouragement and material support of research on the flora of the Coastal Bend. Hannah Croasdale of Dartmouth College kindly supplied the Latin diagnosis.—*Marshall C. Johnston, The Department of Botany, The University of Texas, Austin.*

PHLOX BIFIDA VAR. INDUTA (POLEMONIACEAE), A NEW ENDEMIC IN NORTH CENTRAL TEXAS.—In Edgar T. Wherry's recent monograph *The Genus Phlox* (Morris Arboretum Monographs III, 1955, pp. 68–70), *Phlox bifida* Beck var. *bifida* is described (on the basis of 20 specimens) as having glandular-pilose inflorescence, calyx 6.5–9.5 mm. long, corolla tube 9–14 mm. long, with lobes "averaging 10 by 7.5 mm." and conspicuously notched, the notch usually 3–5 mm. deep. Its range centers in the upper Mississippi Valley, extending southwestward to eastern Kansas and northern Arkansas. *P. bifida* var. *cedaria* (Brand) Fernald (treated by Wherry as ssp. *Stellaria* (Gray) Wherry, l.c. p. 68) is a less pubescent and glandless race found at the southeastern limits of the species, in Tennessee. No variety or near relative of *Phlox bifida* has hitherto been recorded as found wild in Texas, but the rather similar *P. subulata* L. is very commonly cultivated in the northeastern part of the state. On being told that a plant keying to *P. subulata* in

my *Spring Flora of the Dallas-Fort Worth Area* had been found wild in Dallas County, I assumed at once that it was an escape from cultivation. But the collector believed it to be purely wild, and his specimens proved not to belong to *P. subulata*. After comparison with 14 sheets of *P. bifida* in the SMU Herbarium (13 of var. *bifida*, 1 of var. *cedaria*) plus Dr. Wherry's account, it is evident that we have an undescribed race of *Phlox bifida* in north central Texas.

PHLOX BIFIDA var. **induta** Shinners, var. nov. Differt pedicellis calycibusque dense eglanduloso-pilosis, calyce paulo majore (8.5–10.0 mm. longo), corollae lobis brevioribus latioribusque (7–10 mm. longis, 8–11 mm. latis) cum sinu apicali 3–4 mm. alto. Differs in having pedicels and calyxes densely pilose with flattened, translucent, non-glandular hairs, calyx somewhat larger than in the other varieties, and corolla lobes markedly shorter and broader. HOLOTYPE: 4 miles northeast of Garland, Dallas Co., Texas, *W. M. Thompson 1*, April 6, 1958 (SMU; isotype University of Texas). "Sandy loam soils—appearing to be wild in open area among oak trees and scrubby growth. Petals white. Perennial." I am indebted to Mr. Thompson and to his professor at the University of Texas, Dr. B. L. Turner, for specimens of this remarkable plant.—*Lloyd H. Shinners, Southern Methodist University, Dallas 22, Texas.*

NOTES ON THE DISTRIBUTION AND BIOLOGY OF TASTIOTENIA FESTIVA (HYMENOPTERA).—*Tastiotenia festiva* Evans, the only known species of a curious and isolated genus of pompilid wasps, was originally described from females from Guaymas, Sonora, and Needles, Calif.; later a male was described from Borrego, San Diego Co., Calif. (Evans, 1950, Trans. Amer. Ent. Soc., 75: 150; 1954, Pan-Pac. Ent., 30: 103). In the past few years a number of specimens have been collected from various parts of Arizona and southern New Mexico, indicating that the species is more widely distributed and less uncommon than first seemed apparent. Also a few notes have accumulated regarding the biology of the species which seem worth putting on record.

Specimens have now been taken in six counties of Arizona. Records are as follows: Yuma Co., 1 ♀, 2 ♂♂, Yuma, July (G. D. Butler); Maricopa Co., 1 ♀, Gila Bend, March (R. H. Crandall); Pima Co., 1 ♀, Marana, July (G. D. Butler); Pinal Co., 1 ♂, Coolidge, July (C. Williams); Cochise Co., 1 ♀, Mouth of Pinery Canyon, Chiricahua Mts., August (F. G. Werner); Navajo Co., 1 ♀, Joseph City, July (G. D. Butler). All of these specimens are in the collection of the University of Arizona. The New Mexico records were all taken in counties bordering Mexico. Two are from Dona Ana Co.: 1 ♀, Strauss, Sept. (Werner & Nutting) (Univ. Ariz.); 1 ♀, Las Cruces, July (K. V. Krombein) (Coll. Krombein). Another specimen is from one mile north of Rodeo, Hidalgo Co., Sept. (H. E. Evans) (Mus. Comp. Zool.). Several records indicate that the adults visit flowers. Paul D. Hurd, Jr., took both sexes at Borrego, Calif., on *Croton californicus* and *Euphorbia polycarpa*. The specimen listed above from the Chiricahua Mts. was taken on *Aplopappus gracilis*. Specimens from Needles, Calif., and Marana, Ariz., are labeled "mesquite" and were presumably taken on the flowers. Several Arizona specimens were taken sweeping cotton, one sweeping alfalfa.

Notes taken on the specimen from Rodeo, New Mexico, provide some clues as to the probable situation in which this species nests. This female was walking and flying about an open *Tachytes elongatus* burrow in open, sandy desert at 5:35 P.M. Once she entered the mouth of the burrow and ran her antennae over a paralyzed spider which was lying on a small shelf of sand just inside the entrance. She then came out, flew about the area further, and then re-entered, this time going directly

down into the burrow. I remained in the area until dark, but did not see the *Tastiotenia* again. The *Tachytes* was actively provisioning the nest with grasshoppers until dark, but this seemed to have no effect on the *Tastiotenia*. When I left the area I placed an insect net over the burrow, and when I returned in the morning both the *Tastiotenia* and the *Tachytes* were in it. The spider was in the same place as the night before; it had a small wound in the side of the abdomen and a large hole in the venter of the cephalothorax, the hind legs were gone and much of the cephalothorax was hollowed out. Unfortunately I did not examine the spider very carefully when it was first seen, so I do not know whether these wounds were made during the night or earlier.

This is the first known record of a spider wasp preying upon a black widow spider, *Latrodectus mactans* Fabr., for the spider proved to be an immature female of that species (det. W. J. Gertsch). The blue mud-dauber (*Chalybion californicum*, family Sphecidae) is, however, known to prey upon black widows in considerable numbers on some occasions (Irving & Hinman, 1935, Science, 82: 395). It should be emphasized that I did not see the *Tastiotenia* actually move the spider, and it is conceivable that it was left there by some other spider wasp. Whether the *Tastiotenia* made the hole in the spider it is impossible to say. Many spider wasps do feed upon the spiders which they capture, but they do not normally consume this much of the spider and still use it for nesting.

It is regrettable that there are so many uncertainties in this account, and I would not put it on record if the chance of repeating it were not so remote. At least one can say that *Tastiotenia festiva* does at times spend the night in the burrows of other wasps and that probably it nests from the walls of such burrows, in the manner of some other pompilids. That black widow spiders are used as prey by this species (not necessarily exclusively) can also be considered a probability.—*Howard E. Evans, Museum of Comparative Zoology, Harvard Univ., Cambridge 38, Mass.*

AN ADDITIONAL RECORD FOR THE BAT TADARIDA MOLOSSA FROM TRANS-PECOS TEXAS—The big freetail bat *Tadarida molossa* (Pallas) is known from a single locality in Trans-Pecos Texas, and two localities in other regions of the state. A. E. Borell (1939, Jour. Mamm. 20 (1): 65) reported finding a large colony of big free-tails in the Chisos Mountains of Brewster County; Milstead and Tinkle (1959, Southwest Nat. 4 (3): 140), reported a single individual from Lubbock, Lubbock County; and Gerald Raun (Jour. Mamm., in press) found a single specimen hanging from a window screen of the Welder Wildlife Refuge Center, San Patricio County.

On the evening of October 14, 1959, Bert Atkinson and Jack Jones captured an adult male *Tadarida molossa* in the Fine Arts Building of Sul Ross State College, Alpine (Elev. 4485 ft.), Brewster Co., Texas. The specimen was presented to me soon after capture and kept in captivity until it died October 22. The prepared skin and skeleton are now in the Texas Natural History Collection (TNHC 5106) of The University of Texas. Measurements in millimeters are as follows: total length, 133; length tail vertebrae, 50; length hind foot, 5.6; height of ear from notch, 21; length of skull from base of upper incisors to occiput, 23.7; length ulna, 61.6; zygomatic breadth, 12.6; lacrimal breadth, 6.2; least interorbital constriction, 4.3; mastoidal breadth, 10.8; breadth across base upper canines, 4.6; maxillary breadth at M3, 9.3; length of maxillary tooth row, 9.3; length of mandible (anterior face of incisors to posterior tip angular process), 17.5.

Many thanks go to Dr. W. B. Davis of Texas A. and M. College for identifying

this specimen. It was at first believed to be *Eumops perotis*.—*Ralph W. Axtell, Southern Illinois University, Alton, Illinois.*

THE LEECH PLACOBDELLA PEDICULATA HEMINGWAY PARASITIZING APLODINOTUS GRUNNIENS IN OKLAHOMA.—While dissecting a specimen of the freshwater drum, *Aplodinotus grunniens*, taken from the waters of Lake Texoma, Willis, Oklahoma, the junior author discovered a large leech (64 mm. in total length) attached to the flesh between the cleithrum and pharyngeal arch, under the opercle. The fish measured 358.4 mm. in standard length. *Placobdella pediculata* is a rather rare species and has been found only on suckers (Catostomidae) and minnows (Cyprinidae). The drum, then, is a new host for *Placobdella* and this is the first record for this species in Oklahoma.—*Branley A. Branson, Kansas State College, Pittsburg, and Bobby G. Amos, University of Oklahoma, Norman.*

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REVIEWS

ARIZONA FLORA. THOMAS H. KEARNEY, ROBERT H. PEEBLES, AND COLLABORATORS. Second Edition with Supplement by John Thomas Howell, Elizabeth McClintock and collaborators. University of California Press, Berkeley and Los Angeles. 1960. $12.50.

This second edition (the first edition, printed in 1951, was exhausted in 1959) has no changes over the first edition except for the addition of a preface and a supplement by Howell and McClintock. The supplement was made in part from notes and articles by Dr. Kearney (who died in October, 1956) after the first edition. Corrections, additions and nomenclatural changes are included in the supplement, there being no change in the original printing. Howell and McClintock enlisted the aid of the botanists who had collaborated with Kearney and Peebles in the first edition and included the additions and corrections made by them. One Family *(Meliaceae)*, 19 genera (7 introduced) and 68 species were added resulting in a known flora of 3,438 species.

This new edition is welcomed both because the first addition is no longer available and for the additions, corrections and changes made in the supplement.—*Chester M. Rowell, Jr., Texas Technological College, Lubbock.*

INFORMATION FOR CONTRIBUTORS

THE SOUTHWESTERN NATURALIST is open to papers dealing largely or exclusively with the natural history of the Southwestern United States and Mexico. Articles or notes in English or Spanish on the taxonomy, geography, ecology, and evolution of living or fossil organisms of the region are acceptable, as are bibliographical, historical and biographical articles which contribute to investigations in these fields. Priority is given to manuscripts submitted by members of the Association.

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